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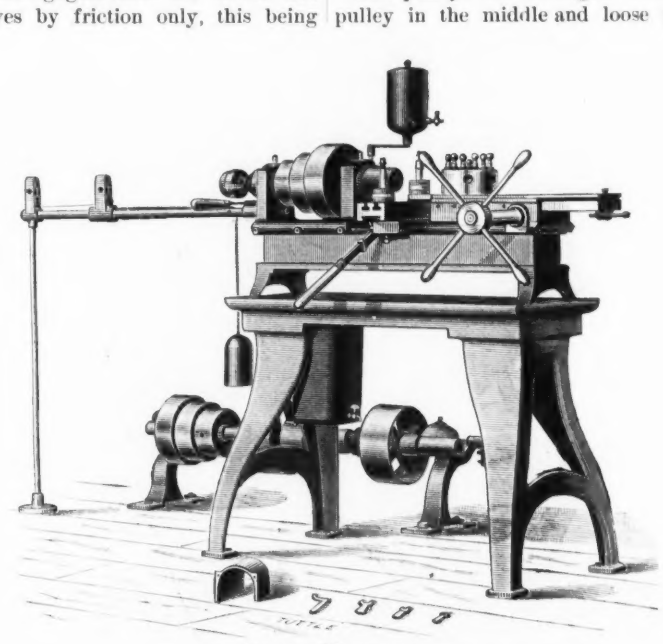
Screw Machine.

The engraving is of a screw machine made by E. E. Garvin & Co., New York City. This size machine is made with or without wire feed, and either with a pilot wheel or a lever for moving the turret slide. The machine is adapted to making all kinds of studs, and screws usually made upon screw machines from $\frac{1}{4}''$ to $\frac{5}{8}''$ diameter. Any length of screw can be made, as the hole in turret goes directly through it. The turret has six holes for the reception of tools. The indexing mechanism for the turret is of hardened steel, and is strong and substantial. The locking pin is hardened and ground, works in an adjustable taper bushing, and fits into hardened taper index sockets in the under side of the turret. The turret slide has a screw stop, and the bearing block is readily adjusted along the bed. The cross slide has two tool-posts, which are each provided with elevating collars, which give a fine and parallel adjustment for tools. The cross slide is provided with a screw stop. The spindle bearings are bronze cap boxes, and all sliding surfaces are scraped to a bearing. The cone is $8\frac{1}{2}$ inches diameter, and has three speeds for $2\frac{1}{2}$ inch belt. There is a large reservoir in the bed of the machine, into which the oil drains, and is drawn off at the bottom.

The machine weighs 950 pounds.



SCREW MACHINE.

Belt-Power Bending Rolls.

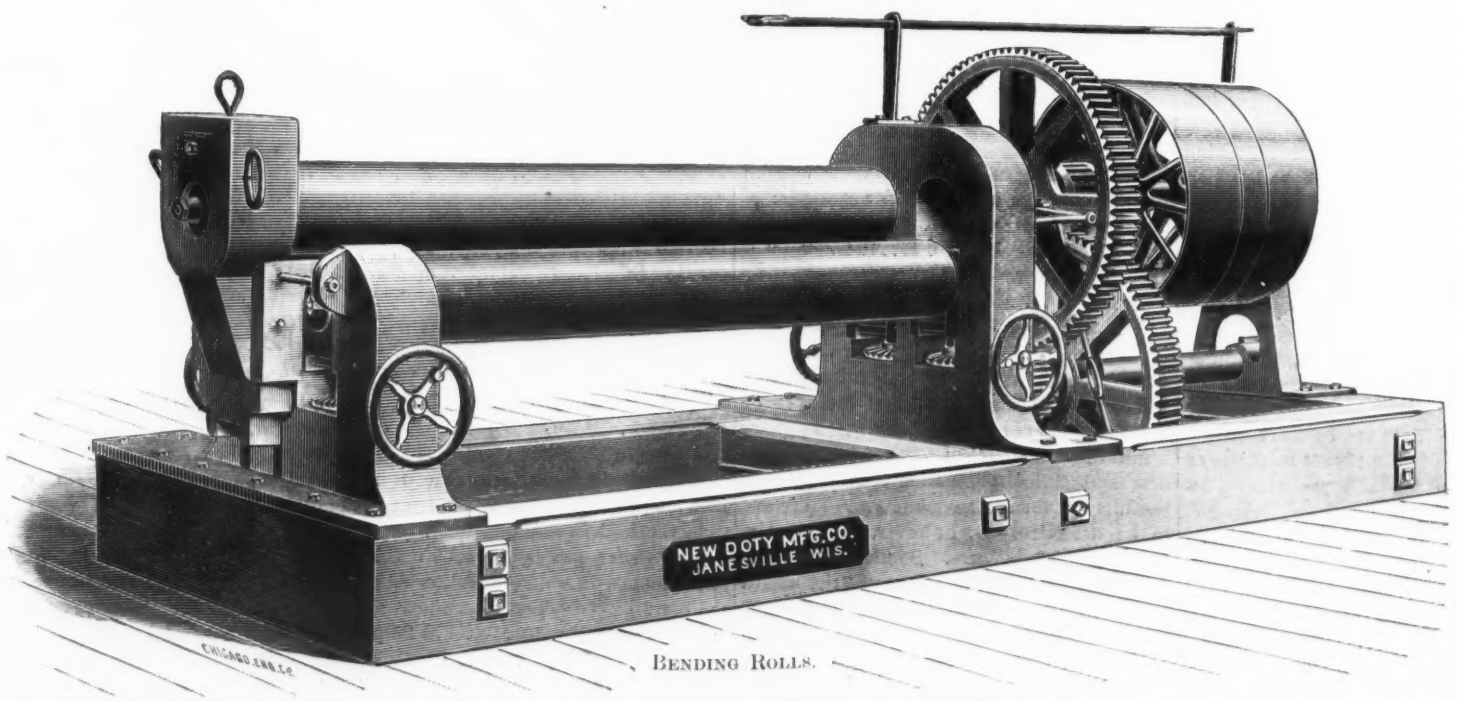
Our illustration is of a set of belt-driven rolls for bending boiler and other plates, built by the New Doty Manufacturing Co., Janesville, Wis.

In this machine, which is built of any desired size, the two rolls which grip the sheets are placed one above the other; the third one, which does the bending, being at the back, and adjustable vertically for giving the desired curvature. The rolls are of iron or steel, as desired, and the housings are made amply strong enough for the heaviest work.

The housing on one end is hinged so as to drop down out of the way, and allow removal of sheet after it is bent to a circle. This hinged housing, when in an upright position ready for work, sets in between two upright pieces on main casting, which pieces hold the hinge in place, and resist all side strain. The top roll is held in position, when the hinged housing is dropped, by a strap which passes over end of roll next to gears, and is tightened by a turn buckle on each side. The two pinching rolls are geared together, and are so arranged that, after making one-half of a revolution they are automatically disengaged and the lower one then revolves by friction only, this being a decided advantage for the reason that it relieves the gears of what would otherwise be the most severe strain they would be subject to. This strain is caused by the fact that one roll coming in contact with the outside or convex side of the sheet, while the other is in contact with the convex side, there must be some slipping if the rolls are geared together, and revolve at the same speed. By releasing the lower roll before the bending commences, this strain is entirely avoided, and much wear and breakage of gears are avoided. The rolls can be connected at any time by a clutch, but are thrown out again after half a revolution.

In all machines having rolls above six inches diameter, the rolls are raised and lowered by a screw worked by bevel gears driven by a belt. Rolls of six inches diameter or less are raised and lowered by a screw worked by hand-wheels, placed beneath the bearings as shown in the engraving.

The pulleys are arranged with the tight pulley in the middle and loose pulleys on each side, then with an open and crossed belt the rolls can be run either way.



BENDING ROLLS.

They Still Explode.

For the past two months we have been hearing of the usual number of threshing engine boiler explosions in the West. The press dispatches announcing these disasters, and giving lists of the killed and injured, nearly always close by saying: "The cause of the explosion is thought to have been a lack of water in the boiler." This is a regular stereotyped phrase, which we have come to expect at the end of every such account.

There is, of course, a reason for this, as there is for every other phenomenon, and that reason is, that nothing is so firmly believed in by the average rural engineer as the saying, which is common among them, that "you can't blow up a boiler as long as you keep plenty of water in it." The sheets may become corroded, the safety valve may be stuck fast to its seat, while the gauge shows anything but the actual pressure in the boiler, which is leaking at every seam; but if anything is said to the man in charge of it, regarding the apparent danger, his answer is almost sure to be: "She can't blow up as long as you keep plenty of water in her." Every one about the engine believes the same, and, of course, when she does blow up the survivors always inform the inquiring newspaper men that "he must have let the water get low in the boiler."

There are people who argue that a man has a perfect right to commit suicide when he thinks he would be happier dead than alive, and in some countries this sentiment is quite generally entertained. If the object of the men who handle threshing machine engines and small saw mill engines were to commit suicide, and no one besides themselves were liable to be killed by the explosions, then perhaps some arguments might be found in favor of the present method of managing these things. There is no other ground upon which we can imagine a defense for it.

One of the most promising schemes for lessening the number of elevator accidents, which have come to our notice, is a plan for having a number of light, but strong platforms arranged above and below the cage, in such a manner, that, as the cage leaves any floor, either in ascending or descending, one of these platforms is detached from it, and left in the opening in the floor, so that any one may walk on to it without danger of falling, the platform, though light, being sufficiently strong to bear the weight of the heaviest person. Not only this, but the rapid spread of fires from one story to another by means of the elevator shaft is prevented. The latter feature of the device is the one which seems to give the most promise of its adoption, for it is not improbable that insurance companies will recognize its value, and so arrange their rates as to make it pay the owners of buildings to put in the improvement. An invention calculated to lessen the risk of fatal accidents is always doubly valuable when it combines some feature which is likely to make its use profitable. Increased safety, when combined with decreased insurance rates, is apt to prove attractive.

A New T-square Device.

All draftsmen know the advantage of a drawing board that can be used in an inclined or a vertical position when desired, but one of the difficulties of so using it is that the T-square often slides down off the board before the desired inclination is reached. To secure the advantage without incurring the inconvenience of working with boards in a vertical or inclined position, Mr. Arthur L. Stevens, a Philadelphia engineer, has devised the arrangement illustrated on this page.

A small cord, in length something over twice the width of the board, passes over pulley wheels placed at a little distance from the working edge of the board, and near the top and bottom. Weights are attached to the ends of this cord, and the center of the cord is caught in a clip which is screwed to the underside of the head of the square. The weights provide a sufficient tension in the cord to hold the square firmly against the board without interfering in any way with its free use, and the square is instantly released from the cord by slipping it from the clip by one finger of the left hand, or it can be as quickly released without the draftsman changing his position from the front of the board. The square can be raised to pass over wet lines; the square may be displaced to draw diagonal lines without releasing the cord. The device works equally well with the board in any position from horizontal to nearly vertical. The device can be attached to almost any board and square in use, and is quite inexpensive.

Bennett & Co., mathematical instrument makers, at 916 Filbert street, Philadelphia, Pa., have made arrangements to manufacture the improvement, and will supply them upon application.

A New T-square Device.

Results of Foundry Tests.

By Robert E. Masters.

Below I give the result of a number of tests showing the breaking strength of a large variety of mixtures of cast-iron. Some of these were made by myself, and some by Rogers, Brown & Co., who are making extensive experiments in this direction, and who are accumulating a vast amount of knowledge, and investigating the character of and uniting of irons. Mr. W. H. Shields, of the firm of Rogers, Meacham & Shields, St. Louis, Mo.—who are associated with the above firm—furnished me with the result of their experiments, and says he will be glad to let me know of any further developments.

There are some wonderful changes taking place in the uniting of irons. Old ideas that have held the foundryman in the toils for the last century or more are being rapidly replaced by new methods, and some of these, too, are almost the reverse of what has always been considered the correct thing. Notably is this the case in the use of close-grain, high silicon iron, or silver-gray iron, to utilize large quantities of scrap in the production of soft castings.

"The results of tests are of 250 cast-iron bars, representing 114 different mixtures of pig-iron and scrap, made in the testing department of Rogers, Brown & Co., from December 17th, 1888, to March 1st, 1889. The bars broken were inch square—corrected to exact size by mathematical formula—and 24″ between supports. The machine used was Riehle's latest improved transverse tester, government standard. All tests were made under supervision of a competent civil engineer.

The strongest bar broke at 1,923 pounds. It contained, in addition to regular mixture of Southern coke iron, Hamilton—a Hanging Rock brand—and scrap, one per cent. ferro-aluminum and a percentage of wrought-iron scrap. It was high mottled, and too hard to work.

The weakest bar—free from flaws—broke at 840 pounds. It was made of a mixture of 50 per cent. each of old car-wheels and No. 1 Lake Superior charcoal iron, a brand of high standing. These two irons were melted together, on account of admitted high standing of each, in order to secure very strong castings for special work. The strongest bar—without ferro-aluminum—was 1,530 pounds. This was from an all-coke iron mixture in an Ohio agricultural shop, in which one Southern and two Ohio brands and good scrap were used in equal proportions. The general average of 250 bars mentioned above was 1,120 pounds. Exclusive of bars containing flaws, of which no account was made, 37 broke below 1,000 pounds, 12 broke above 1,400 pounds, and only 4 above 1,500 pounds.

In deflection or bending capacity the maximum was 53-100 of an inch, the breaking strength being 1,435 pounds. The minimum was one-quarter inch, the breaking strength being 845 pounds.

A study of the data gathered from these tests seems to show that Red Short irons, or those from Lake ores alone, mixed together, make castings weak, hard, given to shrinkage and blow-holes. Cold short irons used alone in mixture tend to weakness and hardness. The highest results are had when different varieties of these classes are mixed in proper proportions. The safest mixture is one combining three elements—Lake Superior, Southern Ohio, and Alabama or Southern Tennessee ores. In these combinations Nos. 2 and 3 grades may be used without making castings too hard. For example:

Southern coke, No. 2	50 per cent.
Lake Superior coke, No. 1	25 " "
Hanging Rock or Jackson coke No. 2	25 " "

This will make a stronger and better casting, as a rule, than No. 1 Lake Superior charcoal, and No. 1 Ohio Scotch made from Lake ores, and at a cost in most localities of $1.00 to $3.00 per ton less.

Mill cinder in Lake ore iron corrects hardness and shrinkage, but renders it more or less dirty, and castings made from it are apt to be defective. It, however, tempers the harshness of Lake ores. Southern furnaces, as a rule, use no cinder, as the district makes little, and ore is much cheaper; its largest use is in Northern and Central Ohio. The use of good scrap, where it can be obtained for a less price than No. 3 strong pig-iron—after making proper allowance for difference between gross and net ton, and difference in waste—is always recommended. It multiplies indefinitely the elements in a mixture. It must, however, be bought with care and watched in using, on account of irregularity.

As pure softeners, high silicon, or pure silvery irons, work advantageously in nearly all mixtures, the proper proportion varying from 5 to 25 per cent., according to high and low silicon in other irons in the mixture. The silicon in the casting should be from two to three per cent., according to the class of work. Instances are noted where three or four very strong irons made weak bars. The addition of 20 per cent. No. 3 silvery iron increased strength over 10 per cent., and made softer castings of better color and grain.

The following is the result of some special mixtures made at Rogers, Brown & Co.'s on bars from Cincinnati jobbing foundry:

Hamilton, No. 2	33⅓ per cent.
Southern coke, No. 2	33⅓ " "
Machinery scrap	33⅓ " "

One bar, poured at middle of the heat, broke at 1,213 pounds.

From a wood-working machinery foundry:

Zanesville, No. 1	37½ per cent.
Woodward, No. 2	12½ " "
Stove scrap	28 " "
Gates and sprues	22 " "

Average strength of six bars broken, 1,304 pounds.

From an agricultural machinery foundry:

Southern coke, No. 2	25 per cent.
Hamilton, No. 2	25 " "
Ironton, No. 2	25 " "
Selected scrap	25 " "

Average of three bars broken, 1,459 pounds.

These tests are being continued, and foundrymen are urgently requested to send bars 1″ square by 26″ long by express, prepaid, to Rogers, Brown & Co., Cincinnati, Ohio. It does not matter from whom a foundryman has bought his iron; to all those who will cooperate with this company, in good faith, sending an accurate statement of the mixture used, and marking the bars plainly 1, 2, and 3, to indicate whether they were poured at the beginning, middle or end of the heat, a report will be promptly returned, showing the breaking strength and elasticity, *no charge being made.*

The main object is to ascertain, by a long line of experiments, the kinds of iron that best adapt themselves to each other to produce the highest results in foundry practice."

The writer has lately been making some experiments, of which the following is among the best:

Rusk (Texas) No. 1	25 per cent.
Coltness (Scotch)	15 " "
Railroad scrap	60 " "

Average of three bars broke, 1,245 pounds.

TEST NO. 2.

Williamson (Alabama)	25 per cent.
Coltness (Scotch)	15 " "
Railroad scrap	60 " "

Average of three bars broke, 1,329 pounds.

TEST NO. 3.

Hinkle (Lake Superior)	25 per cent.
Coltness (Scotch)	15 " "
Railroad scrap	60 " "

Average of three bars broken, 1,413 pounds.

This railroad scrap was a good quality of car and locomotive castings, made principally from Southern irons. In American Machinist, April 23, 1887, I showed the result in shrinkage and breaking strength of a number of brands of iron, and obtained, by mixing different irons, a breaking strength of 1,614 pounds, the highest figure that I know of from a 1″ bar 24″ between points of bearing. And as far back as October 30, 1886, David Spence, in the American Machinist, shows some surprising results, and says: "These tests seem to show that Southern soft and Northern hard iron make a strong mixture, or Northern soft and Southern soft make a strong, tough mixture."

Oil as a Metallurgical Fuel.*

At the Pennsylvania Steel Works, Steelton, Pa., a series of trials has been made with oil as fuel in steel-heating and open-hearth steel furnaces, with the following results:

First Trial.—Hot 14-inch ignots, six to a charge, were heated in two Siemens' heating furnaces in the blooming mill, the oil being put in first in March, 1888. The oil used had been partly refined, so that the paraffine and some of the naphtha were removed. During a run of six weeks the consumption of oil was about 6½ gallons per ton of blooms, including the oil required to keep the furnace hot over Sunday.

Second Trial.—The same partly refined oil was employed for melting in a 30-ton open-hearth furnace, the charge being cold scrap and pig, with ore. Although the gas was carried from the producer to the furnace, a distance of about 300 feet, the oil consumption, as the average of a month's run, was 48 gallons per ton of ingots, including the oil required to keep the furnace hot over Sunday.

Third Trial.—Oil was introduced on June 11, 1888, to heat six Siemens' heating furnaces in the blooming mill, and has since then been constantly used. For a period of six months, including the fuel consumption on Sundays, and including the heating of some cold ingots, the consumption of Lima oil was 6 gallons per ton of blooms. The quantity of oil required naturally varies with the product of the mill. Under the most favorable circumstances—charging hot ingots, and with all the stock supplied which the furnaces can handle—4½ to 5 gallons of oil are required per ton of blooms. Cold ingots must remain in the furnace for about three hours.

Fourth Trial.—Lima oil was used for heating a 30-ton open-hearth furnace, the producer being located near it. As the average of a six weeks' run, 54 gallons of oil were required per ton of ingots, including the fuel consumption over Sundays, and for starting the furnace. The record of the first week was 46.7 gallons of Lima oil per ton of ingots. It was found that the loss is somewhat greater than with coal gas, and that some trouble was experienced from the fact that fine particles of oxidized iron clogged the checkers.

Fifth Trial.—Work in a 5-ton open-hearth furnace, in use since December, developed a fuel consumption ranging between 50 and 55 gallons of oil per ton of ingots.

Sixth Trial.—Oil was applied to the raising of steam under two 100 horse-power return-flue tubular boilers, the temperature of the feed water being about 160° Fahrenheit. The results showed an average evaporation of about 12 pounds of water per pound of oil, the best twelve hours' work being 16 pounds of water evaporated per pound of oil. At the relative prices of oil and pea coal the former is not as economical under boilers as the latter.

In all of the trials the oil was vaporized in the Archer producer, an apparatus for mixing oil and superheated steam, and heating the mixture to a high temperature. From 0.5 to 0.75 pound of pea coal is used, per gallon of oil, in the producer itself.

* Address of E. C. Felton, of Steelton, Pa., at the February, 1889, meeting American Institute of Mining Engineers.

Surface-Grinding Machine.

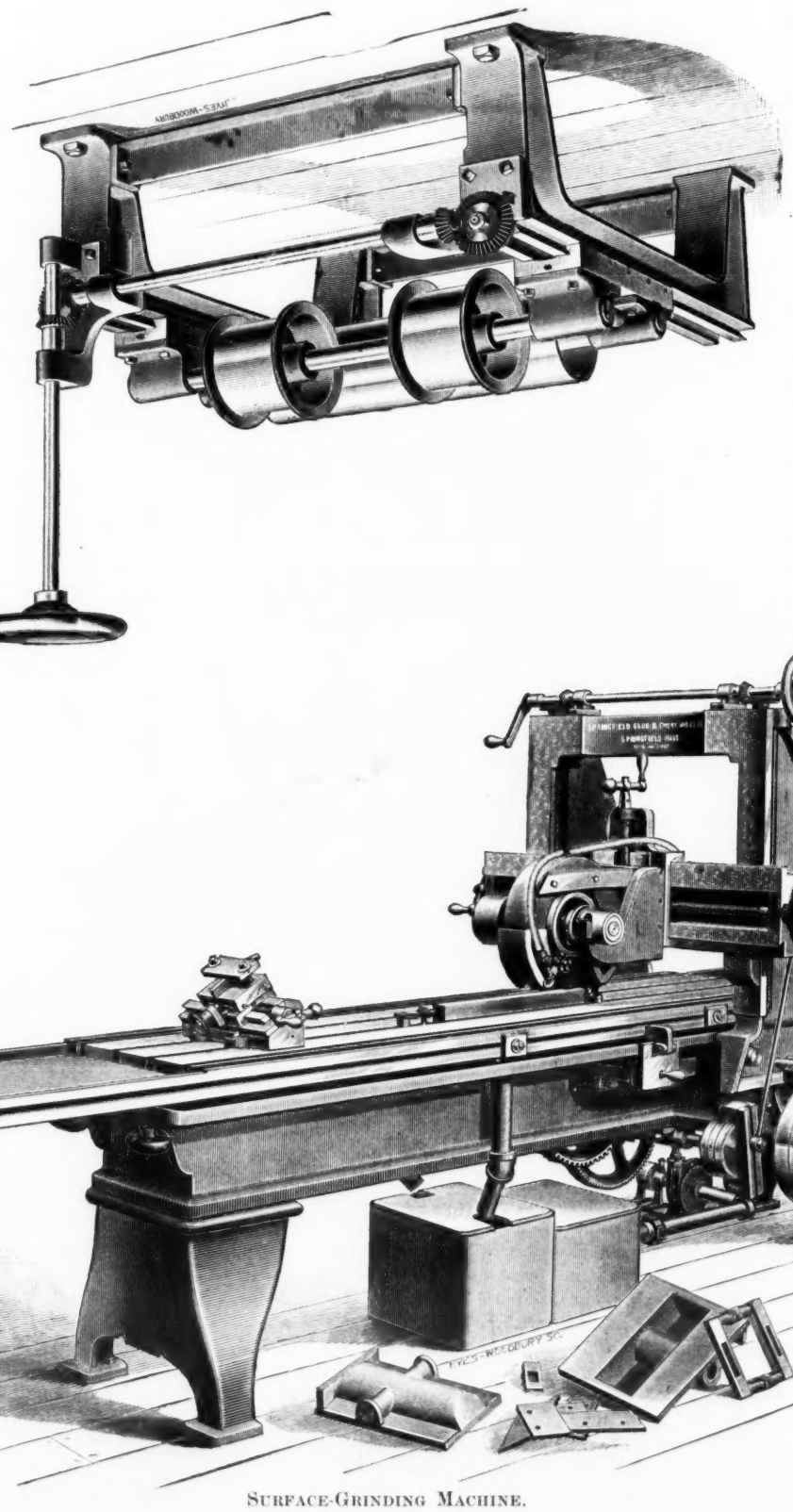
On this page we give an illustration of a machine built by the Springfield Glue & Emery Wheel Co., Springfield, Mass., for grinding plane surfaces of castings which are to be trued up or finished, and yet which it is not practicable to plane, for grinding the surfaces of hardened punching or other dies, or for finishing surfaces which have been planed

As will be perceived, the machine is essentially the same as a planer, having the same motion of the platen imparted to it through the medium of gears and shifting belts arranged in the usual manner. The points of difference consist in the provision for supplying a copious flow of water to the wheel, and for collecting this water in troughs cast at the side of the bed under the platen, from which it is led through pipes to a tank on the floor. The water is allowed time to settle in this tank, the sediment going to the bottom, while the clear water overflows at the top and goes into the smaller tank, from which it is drawn out and again forced up to the wheel by a centrifugal pump also placed upon the floor. Each end of the platen is extended beyond what is usual in planing machines, in order to keep the ways covered as much as possible. The work to be operated upon is fastened to the platen in the usual way, as shown, or any necessary special fixtures may be used.

To keep the belts at a proper tension at different heights of the wheel from the platen, the overhead arrangement shown in the engraving above the machine is used, the belt passing over the pulleys in such a way that a turn of the hand-wheel, which is placed within easy reach, gives the belt the desired tension. A folding hood, which is adjustable to suit different sizes of wheels, covers the wheel in such a manner as to prevent water flying about; and the water, while it keeps the wheel and work cool, and gives a better finish than would be obtained by dry grinding, also prevents dust flying about and lodging upon parts of this or other near-by machinery.

The wheel grinds in both directions, and, when desired, a machine is made in which the wheel is made to move rapidly from side to side on the cross-rail as the work passes under it. This movement is governed by a crank and disk, and is especially recommended for narrow work where but a small amount of stock is to be removed, and there are a number of pieces to grind at the same time.

The machines are made in six different lengths, to grind work from 4 feet to 18 feet long. The platens are 24 inches wide, and work 27 inches wide will pass between the housings. The extreme height of the work from the platen may be 14 inches to 18 inches, according to the size wheel used. The weight of the machine is from 6,000 to 16,000 pounds, according to length. When desired, an additional head is fitted to the cross-rail for planing work, this head being made in the usual form, and with automatic feeds in any direction.



Surface-Grinding Machine.

An American Machinist man happened to be in the Boston & Albany shops at Springfield, Mass., the other day, when an occurrence took place which is, to say the least, somewhat unusual. In the erecting shops was a jib crane, constructed principally of wood and worked by hand, which had been in constant use for all the purposes to which such a crane is usually put in a railroad shop. At the time it did not happen to be in use, and no load was upon it, nor was any one near it, when, without warning, and apparently without provocation, it suddenly fell to the floor, filling the shop with the dust which had collected upon it overhead and that which it stirred up from the floor. Fortunately, no one was in a position to be struck by it, and when it was examined with a view to a possible solution of the mystery, it was found that the upper pintle had broken short off. It was of cast-iron, about two and a half or three inches in diameter, and the break was what would be called a clean one, all the way across. Why it had not fallen when last used is a mystery which it would be difficult to solve. Some of the machinists who gathered about after the fall, thought that the crane had been in use so long as to be entitled to a rest, and, as none was voluntarily granted, it took one. At any rate, the incident is not calculated to be very reassuring to those whose business requires them to be around such cranes. The day before this occurrence an accident happened a few yards away from the shops, which, so far as we know, is the first of its kind. Some heavy stone work is being erected for an approach to the new station buildings. Temporary derricks have been put up to handle the stones, and on this occasion a stone weighing two tons, which had been hoisted, became unmanageable just as a passenger train was going by, and crashed through the side of a car, seriously injuring several people. Both these incidents emphasize the fact that all such machinery used for handling heavy weights should be as secure as possible. There can be no doubt that there is far too much carelessness usually connected with its erection, and it is far too common to take it for granted that, when once built and proven to be sufficiently strong for its work, it will always remain safe without any further attention.

Foreign Engineering Enterprise in Russia.

The anti-foreigner policy, at present prevailing in Russia, has almost completely put a stop to the foreign engineering enterprise so widespread during the reign of the late emperor. It is not simply that the Russian government views with dislike the employment, even by private firms, of foreign labor and skill, but it has turned its back as well against foreign capital. The development of Russian resources it desires to see accomplished by native money as well as native talent, and notwithstanding that this implies slow progress, the authorities declare that they would rather see Russia advance at a sluggish pace under Russian auspices than have her future moulded by foreign hands. Hence, for the moment, foreign capitalists have very little consideration paid them, and not more than a couple of concessions have been granted this year. From a national point of view this exclusion of foreign capital and engineering skill is no doubt very praiseworthy; but we imagine its ultimate results are not properly appreciated by the Russian government. The prosperity of Russia largely depends upon pastoral and agricultural products, which can only find a market abroad if they undersell similar products from America and the colonies. Formerly Russia almost controlled the European market in corn, hides, hemp, wool, tallow, and other similar products. At present, she does not enjoy even a partial monopoly in any one of them, and her exporters find it increasingly difficult to cope with the growing stream of produce from America, north and south, the colonies, and India. Every additional mile of railroad built in America, and every mile left unbuilt in Russia for want of capital, renders this struggle more acute. Last year, owing to the failure of the wheat crop in India and a bad harvest in America, there was a sudden demand of a heavy character for Russian corn, but the "boom" was only ephemeral. This year trade is dull and depressed again, and there is every probability of a serious deficit. Capital naturally flows into channels which receive it the most readily. In Russia foreigners cannot run ranches; gold mining is practically closed to them, notwithstanding that Siberia contains the richest auriferous deposits in the world; they are refused concessions for railways; they are harried by the authorities if they start industrial enterprises, and are impeded if they attempt to buy up old ones. European capital, therefore, which twenty years ago was anxious to flow by millions into Russia, now streams towards America, Australia and South Africa, creating everywhere a rivalry which already exercises a ruinously depressing effect upon Russia. A change for the better is hardly to be expected from a government which prohibits the perusal of Adam Smith's "Wealth of Nations," and other similar books on political economy; but the real sufferer is Russia herself, not foreign capital, which, rebuffed in Russia, has sought productive openings elsewhere, enriching Europe as well as America and the colonies. — *Engineering.*

The American Boiler Manufacturers Association will hold their second meeting at Pittsburgh, Pa., beginning Oct. 15. This Association invites the cooperation of every one interested in the manufacture or sale of boilers, and all such are invited to be present at this meeting. By addressing A. T. Douthett, Secretary, Darragh street and River avenue, Pittsburgh, Pa., additional information as to the objects of this association may be had.

The outcome of the failure of private firms to come within the government terms in the matter of constructing the 3,000 tons steel cruisers is, that they will be built in the government yards. The cost will undoubtedly be greater to the country than if these vessels were built by private firms, but the building of them in government yards will necessitate the putting of these yards in such shape as to make of them something besides political machines, which, in the end, may be a good thing. If it costs fifty per cent. more for the government to do the work of building these cruisers than some ship-building firm would do the work for, an inquiry as to why this is so may reveal something of importance. In any event, the putting of government yards in shape to do such work will be an excellent accomplishment.

Practical Details of Blacksmithing.

By B. F. SPALDING.

SWELLS AND BOSSES—DRAWING STUB-ENDS—WELDING IN PLUGS—OPENING CHISEL—OPENING FROM A SMALL HOLE—GETTING THE REQUISITE STOCK FOR STRENGTH—MAKING SLOTS COLD—PINNING TO LENGTH—ECONOMY OF WASTE.

It is sometimes necessary to make holes in bars of iron so large that, if provision was not made to prevent it, they would quite cut the bars asunder, because the measure of their diameter exceeds that of the width of the bars. One method of preparing the iron for this purpose is to swell the bar out wider at the place where the hole is to be, increasing its width there, in such a form that the hole may be drilled to the required size, and sufficient material be left around it to meet the requirements of strength. The blacksmith takes into consideration the amount of work and time that must be expended in upsetting a bar of the smaller dimensions of the piece in order to enlarge it to the necessary size at the swell, and also that which must be laid out upon a bar of the larger dimensions of the swell, to draw it down to the smaller size, and is guided by the conclusions he forms in selecting the proper size to use.

It sometimes happens that the best way to proceed is to take stock large enough to make the swell, or swells, and draw down a short piece on each end, and weld on to these pieces of the smaller size stock. This is frequently the case in scroll work, and was the plan very generally adopted by the masters of artistically ornamental iron work—now punily renascent in Europe—who were in the height of their fame in the thirteenth and fourteenth centuries. It is used in making parts of carriages, hose carriages, as well, and in many other cases where a proportionally large boss is needed to admit a hole for fastening purposes without weakening the rod it is on. Although it is much easier to upset a piece of iron on the end than anywhere else, it is in many cases easier to draw down larger iron and make what are called "stub-ends," to weld on smaller bars than it is to upset the smaller bar to the right size. This course may be advisable on account of the awkward shape of the piece, which makes it inconvenient to handle, or because the distance from the end to some other point can be most easily obtained by this method of proceeding. Any experienced blacksmith can easily determine how much to allow for a weld, and had rather do this than to test his skill in estimating the amount necessary to cut off to upset a head to a certain size.

Another way to enlarge the bar enough to drill a hole in it of large size, is to drive a chisel down through it, and open it out enough to put in a plug, then stave the plug up, in the hole, and weld in solid. The chisel, used for the purpose of driving through, should be sharp on the front edge and on the side edges, at the cutting end, and should become wider, the side edges round and the blade have an oval cross-section, growing more towards round as it recedes from the cutting edge. See Fig. 1, showing different cross-sections of the chisel blade. The plug, which is of course put in hot, should be large enough when it is upset to make the swell, and allow for the waste in welding.

This principle of throwing out the swell by the insertion of a plug is the same as that used in the process under the drop, except that the plug remains in the drop die, instead of being left in the piece. If the drop plug starts the stock in all directions from the center, it is liable to the same objections which are raised to the following plan, and therefore the shape of the plug, for swelling out stock with a drop die, should be modified to suit the conditions of the work it is to perform. If the successive steps of the operation are not too great, the first entering plug may be considerably longer than the hole it starts.

The plan referred to, of making a hole without too much weakening of the material, but to which objections sometimes arise, is to punch a small hole, first, in the bar, and then enlarge the hole, while hot, by driving a drift or spreading punch into it. Although this may not weaken the piece too much, it will always do so to some extent, sidewise, if not edgewise. To illustrate this matter, we will say that in a bar of iron one inch wide a hole is to be made, one inch in diameter. The hole is started with a pointed punch, like a center punch, which takes nothing out, but pricks a hole through, and forces the stock apart. The punch is driven in the hole, enlarging it as it goes, until it has become an inch in diameter. As nothing has been taken away, it might at first thought appear that there would be as much stock across the sides of the hole as there was in the bar, but it will be seen at once that this is not the case, when it is considered that in driving the stock away from a central point it has gone, not only sideways of the bar, but lengthways, and in all other directions. If the hole, instead of being put into the bar, had been put into a circular piece of homogeneous metal—a disk—it would have spread it evenly all around into a ring, as shown in Fig. 2, where *A* represents the disk and *B* the ring made from it. The cross-section could be easily estimated in this case, but in making a hole in a bar the sides yield first to the force that strains the material, and the more they yield the weaker they become and the greater is the effect concentrated upon them, so that it is not possible to predict how much the stock would be forced away from them, if measures were not taken to avoid it, and when such measures are taken the result is dependent not upon a law, but upon the workman. The difference between these is that in the latter case there is apt to be more variation, allowing that a skillful workman might, by enlarging the hole enough to get the fine point of the anvil horn into it, and then driving on the ends of the bar, get as much stock into the sides as would be contained in a ring made from a disk, it would still be much weaker than before it was punched; for whereas the disk measured one inch, the ring made from it, and having an inch hole in it, would measure in total, for both sides, only four-tenths of an inch, and would therefore be only four-tenths as strong, flat-wise. These facts are so obvious, upon a very slight investigation, that it seems hardly necessary to enter into so much detail; but instances are known where hundreds of thousands of pieces have been made, at useless expense, by this very faulty method, because of a want of a little tractable, intelligent consideration.

If the ring must be of equal strength with the 1″ disk, its sides must each measure ½″, and to make it would require a piece of iron one inch wide, which would have to be 2¾″ long. If a piece of iron of these dimensions, which would work as flawless as gold, should be taken, and a slot cut in it without waste, as long as one-half the circumference of the hole, and the sides thrown out and corners drove in, without making a cold shut, it would just make the ring. It would require iron as good as gold to do this, for the slot would be so long that there would not be half of an inch left at each end of it, so it would cut into the width of the ring. If, therefore, a ring is to be made from a piece of iron just large enough to make it, the corners on the ends must be driven in, and the length required be thus obtained, before the slot is made, or, what is better, the slot must be made shorter. In making a hole through a bar there is not this trouble, for there is length enough of the bar above and below to go on. It is not good practice to leave a sharp impression from the slotting tool at the ends of the slot, where it is to be opened and spread, for it causes too large a part of the strain to concentrate at too small a focus. It should be diffused, and, in proportion, weakened.

To effect this, the bar should be widened out, to allow some stock to be taken out, and a slot made which is round on the ends; if the slot is a little longer than is necessary it is not difficult to shorten it. A hole in a bar can be closed, if it is worked right, easier than one in a ring; the binding power of the ends keeps it from spreading much the same as though it was a ring compressed between a pair of close-fitting swages. In making a slot by driving a chisel in the center of the bar, if the chisel is flat-sided and round-edged the stock thins at the ends and makes places such as are shown in Fig. 3, which are troublesome. The oval or diamond-shaped chisel is better.

Whenever the case will permit it is cheaper to punch the slots cold at a power press than to do it hot at the forge, and it is also a better way because of the greater accuracy which may thus be obtained. An illustration of the advantage gained by doing a part of the work cold is shown in the making of pieces like those shown by the full lines in Fig. 4. The length between the centers of the holes was 14″. The large hole was 2″ in diameter, the small one 1½″, the body was 2″ wide, the width of the sides of the holes 1″ and the uniform thickness ⅜″. Stock was ordered for them cut to the proper length, 2½″ × ⅜″, and ⅜ slots were punched in this, long enough to spread open to the sizes of the holes. The distance from one slot to the other was the same as the distance required between the holes, as this length remained unaltered, whatever changes took place in the stock beyond it. If they had been punched of the same length that was required between the centers, they would have been as much too short as the difference between half the diameters of the holes and half the length of the slots, as is shown in the cuts, Figs. 5 and 4. The pieces were sent to the forge in the shape shown in Fig. 5. There, the slots were opened and pinned out to the right size, ⅛″ being allowed in the diameter of the holes for finishing out in the machine shop. Top and bottom swages of the proper form, but got up cheaply, were used to get the holes central with the bar (see Fig. 6). The finishing pins were put through while the ends were black-hot and the middle red-hot; the object of this was to correct the length. The block, over which the pins were driven, had holes, which were the correct distance apart, and were of the size of the pins. The pins being slightly tapering a part of their length, and then straight until they sloped off for the head, would, by being driven through together, either shorten or lengthen the pieces the little they varied in length from working, and when they cooled off, the only variation in their lengths was that caused by the difference in contracting from the heat at which the pins were last driven through (see Fig. 7).

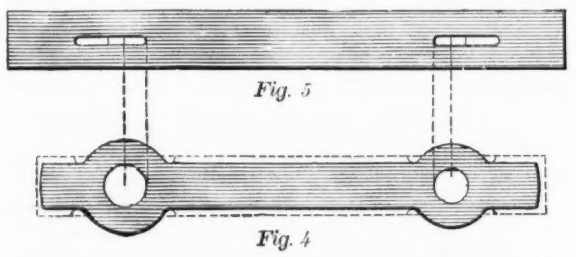


Fig. 5

Fig. 4

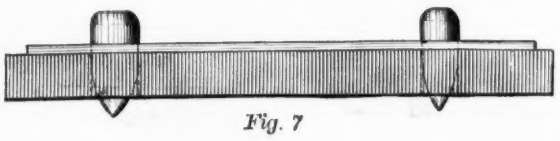


Fig. 7

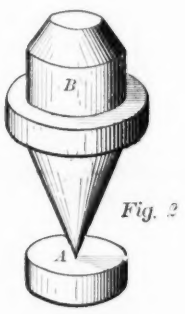


Fig. 2

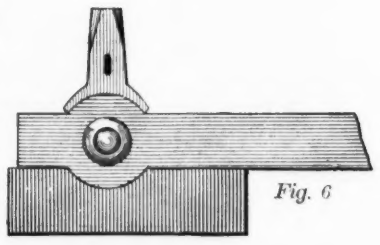


Fig. 6

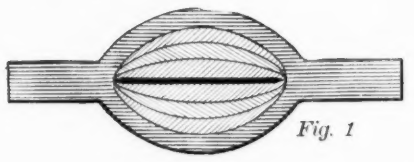


Fig. 1

Fig. 3

When they came from the forge they were still half an inch too wide in the body, and this surplus was taken off at the punch. If there had been a certainty that there would be a large number to make, it would have been economical to make dies to punch them out at once; but as the machine for which they were designed was a pioneer, and experimental, there were only two thousand of them ordered, and they were made with such tools as were on hand. They came to the press straight, flat, and in line, and were put on gauge pins which fitted the holes in such a way that eight strokes of the punch left them in the shape shown by the dotted lines in Fig. 4. They were then sheared to the full lines, being gauged from the holes for this operation, as they had been to cut out the corners. The ends were afterwards cut off to the correct lengths and required form with a horseshoe shaped die.

As these operations left some inequalities on the surface they were taken to the drop, where they were struck a light blow with a pair of smooth flat dies, at a heat which might have faintly exhibited a dusky red hue in the dark. This made them quite straight and level, without altering their length to any perceptible extent. They were nearly as uniform as though they had been run through an automatic edging machine.

The question whether it was cheaper to cut out the half inch in width of stock between the two swells, or to draw it down, had been duly considered, with all the circumstances connected with it, and it was decided to cut it out, because the work could be better kept in uniform shape in this way, and the steps of its progress more clearly defined.

The *Woodworker* says: Perforated blades for band and circular saws are just now attracting attention in Germany, and are apparently giving general satisfaction. Blades of this character, as some of our readers may know, are not entire novelties, but have been known in modified forms for some years. As a general thing, however, their use has been much decried. Still they appear to have some advantages worth considering, and many claims of superiority are made for them. Among them is that of reduced blade friction, due to reduced area of rubbing surface; less tendency to heat, because of the circulation of air through the holes, and economy in power. The holes further prevent the dangerous extension of cracks in the saw blades, and, in general, make it a comparatively easy matter to keep the saws in good running order.

The following circular from the Secretary of the American Railway Master Mechanics Association explains itself. Mr. Sinclair goes to Europe in part to study the practice of compounding on European railroads, which is a very live subject.

NOTICE TO MEMBERS.

I expect to sail for Europe on September 25, to be absent seven weeks. I have to request members who have business to transact with this office to postpone it till I return, and if this cannot conveniently be done, to submit it to President Briggs, Memphis, Tennessee. ANGUS SINCLAIR, Secretary.

Modern Locomotive Construction.

By J. G. A. Meyer.

ONE HUNDRED AND FIRST PAPER.

Rules relating to the strength of helical springs—such as are used for safety valves—have been given by different authorities; some of these rules are not satisfactory, as they do not give results agreeing with practice. The best we have seen are given in "Manual of Rules, Tables and Data for Mechanical Engineers, by D. K. Clark," from which the following formulas have been taken:

$$E = \frac{d^3 \times w}{D^4 \times C} \qquad (1.)$$

in which:

E = Compression or extension of one coil.

d = Diameter from center to center of steel bar composing the spring in inches.

D = Diameter, or side of square of the steel bar, of which the spring is made, in $\frac{1}{16}$ths of an inch.

C = A constant, which from experiments made may be taken as 22 for round steel, and 30 for square steel.

w = Load on spring, in pounds.

The deflection of one coil is to be multiplied by the number of free coils to obtain the total deflection for a given spring. The deflection obtained by this formula for springs made of three-eighths square steel agrees very closely with practice. But for springs made of steel less than three eighths of an inch square we would suggest to increase the constant (30), as experiments seem to indicate that steel rolled to the smaller sizes does not deflect as much proportionally. For steel one-eighth of an inch square a constant of 40 will give better results than a constant of 30.

To find the size of steel for a given spring and pressure, we have the following formulæ, also taken from D. K. Clark's work:

$$D = \sqrt[3]{\frac{w \times d}{3}} \text{ for round steel, (2.)}$$

$$D = \sqrt[3]{\frac{w \times d}{4.29}} \text{ for square steel, (3.)}$$

The letters given in these formulæ represent the same values as given for the first formula.

Example.—How much must a helical spring be compressed to resist a steam pressure of 120 pounds per square inch. Safety valve opening $2\frac{1}{4}$ inches diameter; spring made of $\frac{5}{8}$ of an inch square steel; diameter of spring from center to center of coil two inches; six free coils?

In applying formula (1) we have $d^3 = 2 \times 2 \times 2$. Total pressure on valve equal to area of $2\frac{1}{4}$ inches opening $\times$ steam pressure $= w = 3.97 \times 120 = 476.4$ pounds. Steel $\frac{5}{8}$ square $= 6$ sixteenths, hence $D^4 = 6 \times 6 \times 6 \times 6$. And for the constant C in this example we shall use 30. Hence we have

$$E = \frac{2 \times 2 \times 2 \times 476.4}{6 \times 6 \times 6 \times 6 \times 30} = \frac{3811.2}{38880} = .098.$$

Here, then, the compression for one coil is .098 of an inch; consequently for six free coils the compression will be $.098 \times 6 = .588$, or nearly $\frac{19}{32}$ of an inch.

Example.—The total pressure which a helical spring has to resist is 476.4 pounds; diameter of coil from center to center of steel bar composing it is to be two inches; find the size of square steel required.

According to formula (3) we have

$$D = \sqrt[3]{\frac{476.4 \times 2}{4.29}} = \sqrt[3]{\frac{952.8}{4.29}}$$

$$= \sqrt[3]{222} = 6.05, \text{ say six-sixteenths} = \tfrac{3}{8} \text{ of an inch square for the size of steel bar.}$$

In the ninety-ninth paper, Figs. 554, 555, we have shown a dome top made in one piece, but frequently dome tops are made in two pieces. In the latter design, one piece is called the dome cover, and the other the dome ring.

Fig. 564 represents a section, and Fig. 565 a plan of the dome cover; Figs. 566 and 567 represent the section and plan of the dome ring. The dome ring is riveted to the dome sheet; the manner of fastening the dome cover to the ring, and also their dimensions are plainly indicated in the illustrations.

In nearly all modern locomotives the water is supplied to the boiler by injectors; in a few engines the pump, which in former years was used exclusively, still holds its place, and even in these few cases we sometimes find only one pump which is placed on one side of the engine, and an injector on the opposite side. Pumps are often worked directly from the cross-head; these are called full-stroke pumps. Sometimes they are worked from an eccentric fastened to one of the driving axles, and others are worked from a small crank attached to the crank-pin. The stroke of these pumps is generally less than that of the piston, and therefore they are called short-stroke pumps.

Our illustrations represent a full-stroke pump designed for an eight-wheeled passenger engine. Fig. 568 represents a section;

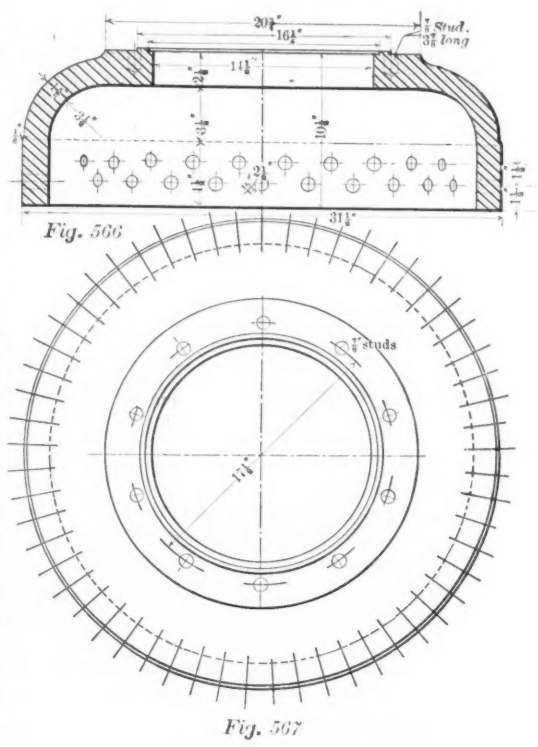


Fig. 566

Fig. 567

Fig. 564

Fig. 565

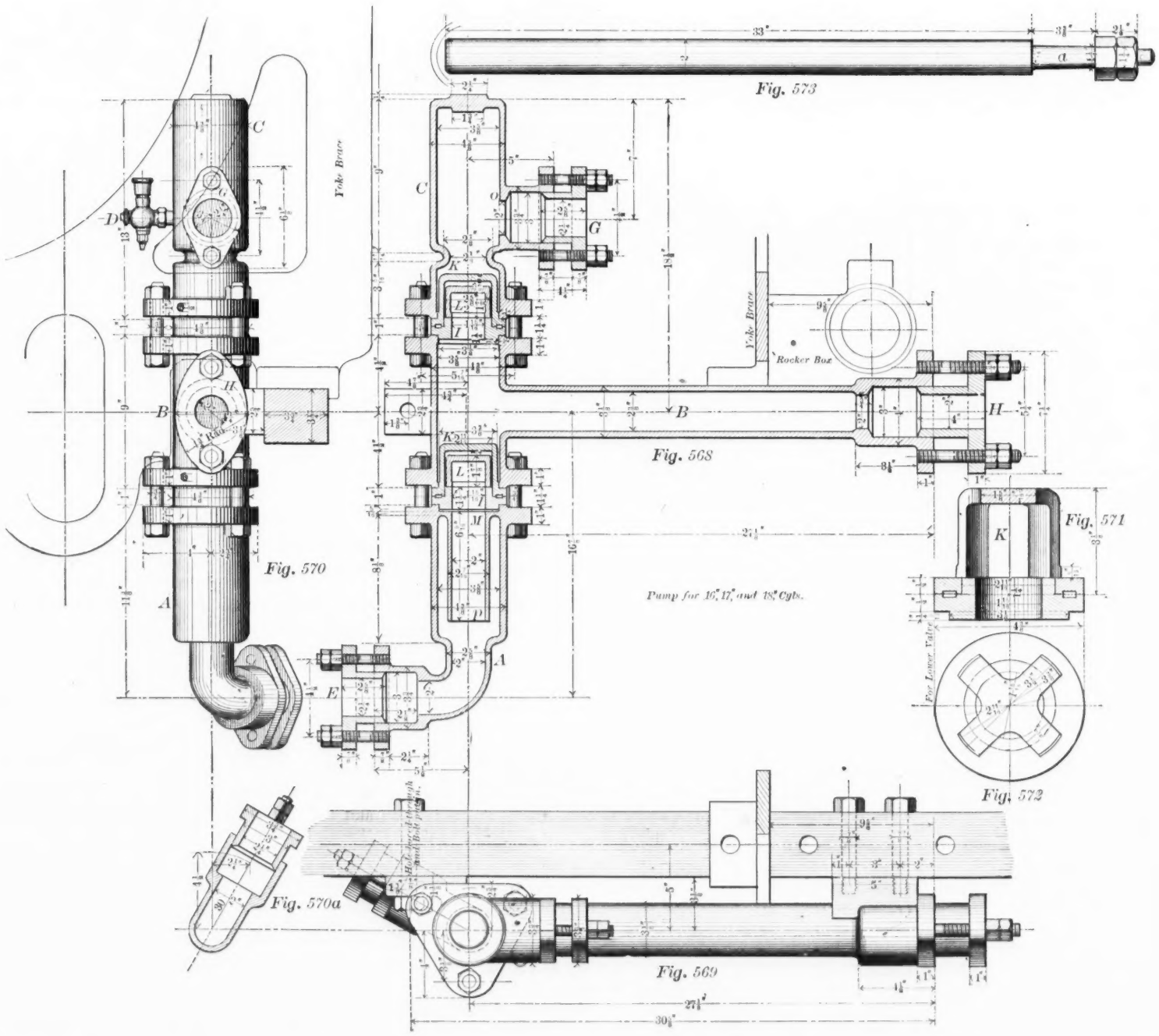


Fig. 573

Fig. 570

Fig. 568

Fig. 571

Fig. 572

Fig. 570a

Fig. 569

Fig. 569 a plan; Fig. 570 an end view of the pump, and Fig. 570*a* a section through the lower stuffing-box and gland. The pump consists of the barrel *B*, the lower air chamber *A*, the upper air chamber *C*, the valves *L L*, the valve seats *I I*, and the cages *K K*. The valves are cylindrical in form, and rest on the seats *I I*, the latter resembling ordinary discs. The upper valve seat rests on the face of the flange of the barrel, and the lower valve seat rests on the face of the flange on the air chamber. The cages rest on the valve seats, the whole being clamped together and held in position by the bolts through the flanges of the air chambers, and those of the barrel. The joints between the flanges, valve seats and cages are ground joints. An enlarged section and plan of the cage and valve seat are shown in Figs. 571 and 572. The purpose of the cage is to guide the valve, and prevent it from lifting too high.

The barrel and air chambers are often made of brass; sometimes of cast-iron; the valves, seats and cages are always made of brass.

The stuffing-box on the lower air chamber receives the end of the suction pipe, and a water-tight connection is made by means of the hemp packing in the stuffing-box *E*. The stuffing-box on the upper chamber receives the end of the delivery pipe, and here, also, a water-tight connection is obtained by means of the hemp packing in the stuffing-box *G*. The suction pipe extends to the rear end of the engine, where it is connected by a rubber hose to the tank. Since the suction pipe is comparatively a straight pipe, it is often made of iron, sometimes of brass. The delivery pipe extends to the check valve on the boiler, and because the delivery pipes have to be bent, they are made of copper.

The manner of fastening the pump to the frame *F* is plainly shown in Fig. 569.

Fig. 573 represents the plunger; it is made of a wrought-iron bar, with a tapered shank *a* turned at one end. This shank fits in a lug either cast or bolted to the crosshead.

In a pump of the size here shown, the lift of the lower valve—sometimes called the suction valve—is one-quarter of an inch; and the lift of the upper valve—sometimes called the delivery valve—is $\frac{5}{16}$th of an inch. The successful working of the pumps depends to a considerable extent on the correct amount of lift, hence the necessity of exercising great care in determining the lift; too much lift will prevent a quick closing of the valve, it will also cause it to pound, thereby ruining the valve seat.

The air chambers are for the purpose of relieving the pump and its pipes from sudden shocks, which are liable to occur by the rapid motion of the pump plunger. For instance, as soon as the water rises above the top of the opening *o* in the upper air chamber, the air in the latter will be compressed, and act as a cushion, thereby reducing the intensity of a shock. The lower air chamber is arranged somewhat different; a pipe *M* extends from top towithin a short distance from the bottom of the chamber, so as to leave an annular air space. This pipe *M* is called a dip pipe. As soon as the water reaches the lower end *p* of the dip pipe, the air in the annular space is compressed, and has a similar effect as the air in the upper chamber. It must readily be perceived that when the lower air chamber does not contain a dip pipe, the chamber will soon be rendered useless, because the air in it will be replaced by water.

In many locomotive pumps the water is discharged through the top of the upper air chamber, instead of through its side, as shown in our illustrations. In cases of this kind the upper chamber must be arranged similar to the lower one; that is to say, it must be provided with a dip pipe extending from the top of the chamber to within a short distance from its lower end; otherwise the chamber will soon be filled with water, and rendered useless.

The air capacity above the water line in the upper chamber should be equal to the total displacement in cubic inches of the pump plunger; in fact, one and a half times the displacement will give better results. Thus, for instance: Let the plunger be two inches diameter, and twenty-four inches stroke. The total displacement of the plunger is found by multiplying its cross-sectional area by the stroke. Now, the area of a cross-section two inches in diameter is 3.14 square inches, hence the total displacement will be $3.14 \times 24 = 75.36$ cubic inches. Consequently the air capacity of the upper chamber should not be less than 75.36 cubic inches; and $75.36 + \frac{75.36}{2} = 113.04$ cubic inches will be better.

The inner diameter of the dip pipe must be equal to the inner diameter of the suction or feed pipe; and since the air capacity in the annular space should be equal to the air capacity of a plain chamber, it follows that air chambers provided with dip pipes will have larger outer dimensions than plain chambers.

The air capacity of the lower air chamber can always be made a little less than that of the upper one.

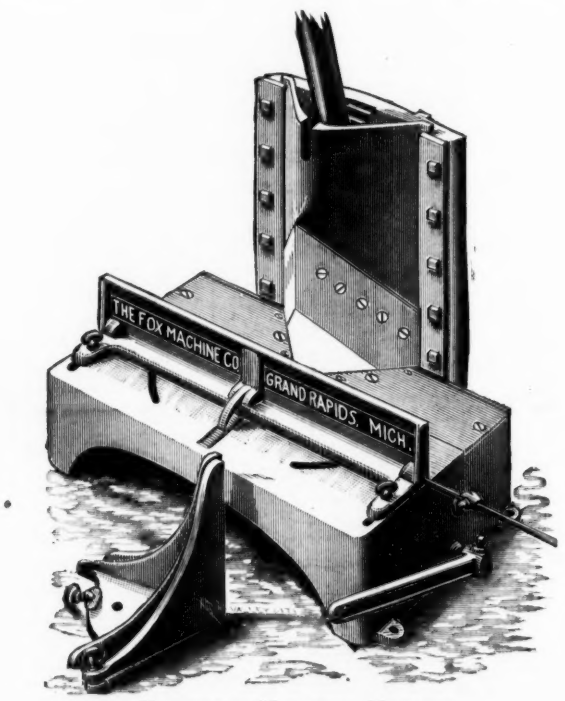
The small pet-cock *D*, shown in Fig. 570, is for the purpose of ascertaining whether the pump is feeding water into the boiler.

LETTERS FROM PRACTICAL MEN.

Cast-Iron Bearings.

Editor American Machinist:

Mr. Slate's penchant for cast-iron bearings is, I believe, well founded. Cast-iron running on cast-iron has long been received as the best in England.



UNIVERSAL MITERING MACHINE.

In cotton machinery the beaters or scutchers, which revolve at a high velocity, have the journals fitted with cast-iron collars, and these revolve on cast-iron with perfect satisfaction.

Apart from the excellence of the cast-iron bearing, it is worth noting, also, that a cast-iron shaft or spindle will run far better on a gun-metal bearing than will a shaft of wrought-iron.

When I was first apprenticed, the days of 30-pound steam boilers were about closing, old slow-speed engines of the Boulton and Watt, or rather Fairbairn stamp, were looked upon as getting played out, and piston speeds of 300 and 350 feet were becoming voted slow; but I assisted to speed up a pair of large beam engines of eight feet stroke to a piston velocity of about 420, which was looked on as pretty good, and it scared the owner to see these large engines move off at their new speed, the old speed having been about 280. Now in all the old beam engines the crank-shafts were made of cast-iron, and I need hardly say how very much cheaper a cast-iron shaft is than one of wrought-iron.

Not only were they cheaper by far, but very much better also, for they did not flute and score in the necks like wrought-iron, and we are all familiar with the appearance of a wrought-iron neck of long standing, or rather running. The bearings were gun-metal, just as with wrought-iron, though I could never see why the "brasses" should not have been of cast-iron also, in a district where so many cast-iron bearings were in use in every factory for which the engines were made. Of course the cast-iron shafts did sometimes break, usually just about inside the neck bearing; but this, of course, is a common enough fault of wrought or even steel shafts, and was as likely as not due to the error in making necks smaller than the next contiguous portion of the shaft. The necks of engine shafts ought to be larger than the adjoining part of the shaft; not smaller, as is the usual custom.

Nothing is simpler than to cast a sound shaft of iron. Cast horizontally there is, as in all castings, the danger of one side of the shaft being much less sound than the other. We always cast them vertically, and so obtained at one end of the shaft a very great compression, and at the upper end a sufficiency of head could always be used to get sound casting and receive all air bubbles above the portion to be used. Otherwise my notes are not very clear. I believe they were usually cast about parallel, and simply turned down at the necks, and having little or no middle swell for the wheel. Of course for single engines the wheel swell was at or near one end. Of course a shaft for casting end up can be moulded horizontally, the whole mould being put upright in the pit, and rammed up in sand to take the pressure, which would otherwise burst the mould, a shaft twelve feet in length exerting a fluid pressure per square inch of quite forty pounds to the square inch, including head or riser, on the lower end of the mould.

Is there any good reason why many shafts and spindles should not be sleeved in cast-iron? In cotton carding engines, cast-iron sleeves on the ends of rollers run better on brass than the wrought-iron ones, and it is most probable that the bearings of many score scutchers in New England will be found on inquiry to be of cast-iron, as they are with us. Why the excellent wearing qualities of cast-iron for rotating bearings has not been more generally recognized is difficult to understand, in face of the many examples of straight rubbing surfaces, such as guide blocks on cast guides, pistons in cast cylinders, slide valves on cast faces, and the many sliding parts of a lathe and other machine tools, not to mention toothed wheels; and nothing runs better than a cast-iron eccentric sheave in a cast-iron strap. In fact, there are thousands of examples always before us of the immense superiority of cast-iron, but we persist in using wrought-iron, even when not compelled by considerations of safety. But why cast-iron should be allowed to hold steam in contact with much water of equal temperature is past finding out.

W. H. BOOTH.

A Suggestion About the World's Fair.

Editor American Machinist:

I received last week, in common I suppose with other members of the American Society of Mechanical Engineers, a circular containing suggestions for an Exhibition Building for the proposed celebration of the discovery of this continent in 1492. As to the proposed plan I have little to say, except to refer to Prof. Sweet's letter in the AMERICAN MACHINIST, and his comment, that "bigness" neither implies magnificence nor beauty. Such a dome as is suggested would probably be the most expensive way of covering in an area for Exposition purposes that could be devised. There is, however, another point to which I wish to call the attention of the readers of the AMERICAN MACHINIST, and that is the suggestion of my friend, Edward Atkinson, to the New York *Herald*, to have the proposed Exposition show the progress made in the arts and sciences, from the time of Columbus to the present time, and I would enlarge on Mr. Atkinson's suggestion in this way: Let the Exposition show, if possible, not only the total advance, but the various steps in its progress, and especially those due to American inventors. For instance, in the cotton industry, begin with Whitney's gin, some early example of which can, no doubt, be secured, and come down with all the improvements to date. Show Aza Arnold's differential motion, usually wrongly credited to Henry Houldsworth, who took out the English patent, as applied to the roving frames, the ring spurring frame, the rabbette spindle, the Mason mule, Whipple's cloth shear, etc., etc.

Show the growth of the locomotive engine, with all the American improvements on that, the progress of machine tools, up to the work of Pratt & Whitney or Brown & Sharpe, and so on through all the great branches of mechanical industry, and begin about the matter in season, before all the early examples are sent to the cupola or the scrap-heap.

Almost all these things will fall within the range of the present century, without going any further, but our English cousins might be called upon to send us some things, half a century older, such as one of Boulton & Watt's old engines; I remember seeing one at Lowmoor in 1850, and we could compare with the Compound Automatic Corliss of to-day.

In firearms, we might trace the successive steps from the arquebuse of the days of Columbus to the Colt or Remington magazine, and the American tools for gun-making and rifling would be an important feature. In fact, it is not worth while to attempt to enumerate the various improvements of all kinds which we might collect, and first and foremost, perhaps, should be put agricultural machinery.

There are hundreds of minor inventions besides. The Merrimac Co. of Lowell might show the original Pentagraph engraving machine, now largely used by calico printers, the invention of Milton D. Whipple, and the Middlesex Co. can show the original machine of the same inventor for twisting the fringes of shawls.

It has seemed to me that the AMERICAN MACHINIST was a good medium through which to make these suggestions, and I therefore send them to you.

SAM WEBBER.

Universal Mitering Machine.

We present with this an engraving showing the construction of an universal mitering machine, made by the Fox Machine Co., Grand Rapids, Mich. The machine, which is designated by the makers the "No. 4," is designed for both mitering and trimming, the miter gauge being moved to and from the knife by a parallel movement, and automatically locked in any position. The miter gauge carries a stop for gauging the length of the moulding to be cut. By removing two thumb screws, the miter gauge can be quickly removed, and the central post which supports the squaring gauge placed in position. These gauges are so arranged that the edge next the cut made by the knife is always a shearing one, in whatever position they may be placed. This makes the machine answer equally well for either trimming or mitering square or at any

angle. The carriage being in the form of a triangle, firmly braced, and with long bearings well fitted and gibbed to the frame of the machine, makes a firm support for the knives, and causes them to move in a true plane.

Motion is given to them by means of a lever and a pinion, which latter rolls between two racks, one of which is located on the frame, the other on the carriage. This gives an equal and effective leverage at all parts of the stroke, and works with little friction. The steel bed-plates, which form a shear cut with the knife, are fitted into the bed, which, being adjustable, can be elevated next to the knife, thereby making an under cut on the moulding—a valuable feature on some classes of work. The machines are also made for making cuts of special shapes.

There is Nothing to Back It.

There has recently been considerable loose talk by the daily press in regard to the examination of engineers for service under United States license laws. It has been assumed that because an examiner has retired, and the examination of candidates has temporarily been in the hands of Supervising Inspector Starbuck, that the business is not properly attended to. As a matter of fact, Mr. Starbuck is an engineer by virtue of having graduated as such from one of the very foremost schools in the country; and as a manufacturer he has for years built and placed engines and boilers, both stationary and marine. We write this merely in the interest of justice, and against loose talk that does not center on any single point. There is nothing that we can see to back of incompetency—that is, nothing that comes under the head of square dealing—and it is an injury to the service.

A Dubuque (Ia.) dispatch says: The lead mining industry in this region has been in a comatose condition for some years, but a discovery made yesterday at Sinsinnawa Mound has caused new excitement in the business. Three miners have been prospecting for some time on a farm about two miles north of Sinsinnawa Mound. While following an old lead, one of the men struck a blow with his pick which opened up a cave. It was fully excavated, and a chamber about twenty-two feet square was disclosed. It was filled with great chunks of native galena, almost pure, some as large as water buckets. The three miners are jubilant, and expect to make further discoveries. A number of other miners are leaving to prospect in the same region.

We receive many inquiries from mechanics in relation to engaging themselves to go to Mexico or South America to work at their trades. There are, no doubt, sometimes good positions secured in this way, but a good deal of judgment should be exercised in accepting offers of such positions. There are plenty of unprincipled men who, for a consideration, will engage men to go to these countries, and when they get there they find things anything but as they were represented to be. The moral is: Always work in such matters with your eyes open, and before you go to a strange country find out something about it. Doing this will often save a good deal of future trouble.

The labor men of Brooklyn, N. Y., have come to the conclusion that it would be a good thing to have a man in the board of aldermen who knows something about the requirements of the city in the way of plumbing and sewerage, hence they have determined to support such a candidate. It would be a good idea if men were generally put forward for public positions who knew something about the duties pertaining to these positions; but that would not be politics. This move of the Brooklyn labor men may be a good one in an educational way.

Just now the great coal operators of the West seem willing enough to bring about a settlement of their differences with their workmen. Mr. Scott appears to have receded from the ground he took—not to treat with any organization—and is now willing to bring about a resumption of work on some sort of terms.

Force, Motion and Work.

By Pedro.

SECOND PAPER.

UNIFORM MOTION.

Having considered some of the elementary principles of motion in general, we will now study the laws of uniform motion. What is uniform motion? We have seen that the velocity of a body is the distance it moves in one minute. If this distance is the same for *every minute* while the body is in motion, then the motion is said to be *uniform*, or the body moves with a *constant velocity*. Let us take the ball again as an example, and suppose that it is moving from A towards E, Fig. 1, with a velocity of ten feet. Its velocity being ten feet, it will move from A to B, a distance of ten feet, in the first minute, and, its velocity being uniform, it will also move ten feet during the second minute from B to C, ten feet in the third minute from C to D, and ten feet in every other minute while it is in motion. It is evident, then, that the whole distance the ball passes over, from A to E, in any given time, is as many times ten feet as there are minutes (including fractions) in the time that the ball has been moving; hence, if we represent the

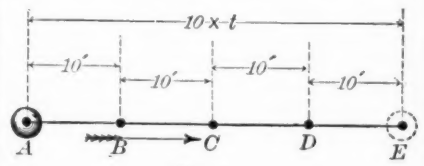


Fig. 1

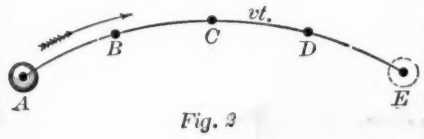


Fig. 2

velocity by v, the time during which the ball moves by t, and the space or distance passed over in the time t by s, then

1. . . . . $s = v\,t$.

That is, if we know the velocity and the time during which any body moves, then to find the space it moves over in that time:

Rule 1. *Multiply the velocity by the time;* the product will be the space passed over.

Example.—If a train moves with a speed of $\frac{3}{4}$ of a mile a minute and it is on a steady run of two hours, or 120 minutes, what is the distance traveled?

Distance $s = \frac{3}{4} \times 120 = 90$ miles.

From equation 1 we deduce at once the following:

2. . . . . $v = \frac{s}{t}$

Rule 2* Given the space and the time during which a body moves, what is its velocity? *Divide the space by the time;* the quotient will be the velocity.

Example.—A train makes the run of 90 miles in two hours; what is its speed?

Speed $v = \frac{90}{2} = 45$ miles an hour, or

$v = \frac{90}{120} = \frac{3}{4}$ of a mile a minute.

Again, from equation 1 we get

3 . . . . . $t = \frac{s}{v}$

Rule 3. Given the velocity and the distance a body moves, how long will it take to travel that distance? *Divide the space by the velocity;* the quotient will be the time required.

Example.—A train travels 200 miles with a speed of 40 miles an hour; how long will it take to make the run?

Time $t = \frac{200}{40} = 5$ hours.

These rules apply to a body moving in a curved line of any form, as in Fig. 2, as well as a straight line, as in Fig. 1, the distance always being measured along the line or *path* of the body as it is called.

* These rules are simply explanations of the operations indicated in the preceding formulas which have the same number.

A Decimal Association.

We think no one who has ever made a comparison between our American decimal system of money and the British system of pounds, shillings and pence, can have failed to be impressed with the vast superiority of the former in point of simplicity and the convenience of making computations. There are, of course, plenty of people in Great Britain who fully appreciate this superiority, and are aware of the great advantages of decimal systems generally; and these people have recently formed there a Decimal Association, the object being to bring about the adoption in Great Britain of a decimal system of notation in money, weights and measures. We do not understand that the association favors the French metric system particularly, though that is, of course, a pure, consistent and complete decimal system, but it seems to favor rather the introduction of such systems by taking a value or magnitude already in use, and dividing or multiplying this by tens, hundreds, etc., the unit retained being chosen with a view to causing the least possible inconvenience. For a number of years past there have been spasmodic efforts to attract public attention, in Great Britain, to the desirability of introducing decimal systems, but nothing has so far come of it. That considerable interest has at last been aroused in the question, however, is shown by the fact that a pamphlet, in which the plan of Mr. R. T. Rohde is set forth, has met with a very favorable reception, more than 130,000 copies having been sold

Mr. Rohde proposes that the British sovereign be retained as the standard coin of the country, but instead of being divided into shillings and pence, as at present, it be divided into five dollars British sterling, each dollar being divided into one hundred cents, each of which will, of course, very nearly equal the present half-penny.

Now if things could be so arranged as to make such a British sovereign equal to just five U. S. dollars instead of $4.87, a considerable benefit would result to the commercial and manufacturing interests of both countries, though none would appreciate the value of the arrangement more than our American school children. Of course we do not give all that Mr. Rohde proposes with regard to coinage, but only the main features.

In the department of weights he proposes to use a uniform standard of 100 pounds avoirdupois, containing 7,000 troy grains, as at present, but divided into decimal parts, as 100ths, 1,000ths and 10,000ths. For linear measure his proposal is to retain the foot at present used, but to divide it into 100 parts, ten of these parts making one decimal inch, and therefore, of course, ten of these decimal inches making one foot. The squares and cubes of this foot, with decimal multiples and subdivisions, may be used for area and solid contents. As a measure of capacity he proposes to use, as a "decimal pint," a vessel which will hold one-tenth of the imperial gallon, or one pound of distilled water at a temperature of 60 degrees Fahrenheit; this measure being again divided into 100 parts, each equal to .01 of a pound of similar water.

So far as we can see, this plan, or a similar one, would come so near realizing all the practical advantages of the metric system, that it would scarcely be worth while to talk of the difference. And its adoption would be attended with only a small fraction of the disarrangement and loss which would attend the introduction of the metric system. In fact, it is not unlikely that the benefits derived from such a change would be a full compensation to most of those helping to introduce it. We are inclined to think that, instead of retaining the foot as at present, and enlarging the inch to make ten inches to the foot, it would be better to retain the inch as it is and reduce the foot to make it contain ten of the present inches. This would make all dimensions expressed in inches have the same value as now, and it is probable that the vast majority of dimensions are, at present, given in inches and fractions of an inch.

For practical reasons, which we have before explained, we do not think the general adoption of the metric system is practically possible, though it must be admitted that, considered simply by itself, and without reference to the difficulty of introduction, it is an admirable system. But its advantage lies principally in the fact that it is a purely decimal system, and, if a decimal system can be introduced which will not require the abandonment of the principal units now in use, it is certainly worth while to inquire if it would not be well to have the tendency in that direction if possible. Americans, who have every opportunity for seeing the advantage resulting from a decimal system of coinage and money, should be the last to resist its introduction in other departments, when it can be shown to be practicable to do so.

After a long fight, the Third Avenue Railroad Company has received permission to move its cars by means of a cable instead of by the use of horses. Just why it has taken so long to secure this permission is one of the things that the uninitiated are not likely to find out. It has been apparent for some time to every one who has given the subject any thought, that horse-power on railways must give way to some other means of propulsion, but the authorities in most cities seem inclined to make the change troublesome to the railway companies. Still, the horses must go.

Several workmen were sent from the Woolwich Arsenal (England) to France to report upon, amongst other things, the condition of working men there. One of these workmen has reported upon the condition of the men at the French Arsenal. The workmen there, according to his report, receive 8, 9, and 10 pence per hour (16, 18 and 20 cents), and double time for overtime. They are allowed to sit down, and to smoke while at work, the opinion being that this is advantageous. A very good condition is shown for the French mechanic.

There are extensive strikes and rumors of strikes in Europe. The latest is the outcome of a strike of the dock laborers in Rotterdam, the strike extending, as in London, to the trades and amongst other laborers. Everywhere there appears to be a feeling amongst workingmen that they are not getting their share of the products of labor, and this feeling finds expression in strikes, which are, to say the best, very clumsy and unsatisfactory means of settling labor disputes.

When people get out of their sphere they sometimes come to strange conclusions. An example of this was a recent verdict by a Chicago jury to the end that a certain man killed another one with a specified revolver, although it was demonstrated that the ball that did the killing was about an eighth of an inch larger than the bore of the revolver.

According to the anti-trust law which recently went into effect in Missouri, the Secretary of State is authorized to bring suit to revoke the charter of any company entering a trust; and he is authorized to require every company in the State to answer certain questions as to whether or not they belong to a trust.

It is quite a serious thing to keep the railways in Australia free of weeds, the cost of doing so being estimated at about $80,000 per annum. Recently a machine has been devised for doing this work. It is said to work satisfactorily, and to save a good deal of money.

There appears to be a general move for an increase in wages in England. Nearly all kinds of manufacture is, so to speak, booming there, and increase in wages will help the boom.

Now there is a scheme to build a tower mainly of gas pipe, for the 1892 exhibition that shall exceed in height the Eiffel tower What a silly scheme it is, to be sure!

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CONTENTS.

	PAGE.
Screw Machine	1
Belt-Power Bending Rolls	1
They Still Explode	1
A New T-square Device	2
Results of Foundry Tests. By Robert E. Masters	2
Oil as a Metallurgical Fuel	2
Surface-Grinding Machine	3
Foreign Engineering Enterprise in Russia	3
Practical Details of Blacksmithing. By B. F Spalding	4
Modern Locomotive Construction. By J. G. A. Meyer	5, 6
There is Nothing to Back It	6
Force, Motion and Work. By Pedro	6
A Decimal Association	6
Save the Park	8
Railways in China	8
Taxation of Manufacturers	8
Questions and Answers	8, 9
Manufactures	9
Machinists' Supplies and Iron	10

Save the Park.

The Site Committee of the World's Fair appear, at this writing, determined to take part of Central Park for the exhibition. In coming to this conclusion, we think the committee makes a serious mistake. Already the idea that part of the people's playground is to be sacrificed, has dampened the ardor of a good many New Yorkers, so far as the fair is concerned. The people have seen the Battery Park and City Hall Park taken piecemeal, and the feeling is strong that Central Park shall be preserved. If the cutting up process is begun it will very likely continue; this is the argument, and it is sound.

Whatever may be said to the contrary, such part of Central Park as is taken for the fair—and it will be a generous slice—will be substantially lost to the people of this generation. Trees will be destroyed, that cannot be replaced in years, and the grounds will be otherwise disfigured. Then there will be permanent buildings that will forever reduce the pleasure area.

If there were no available location, without intruding upon the park grounds, there would be some excuse for considering them as a site. Even then we believe it would be better to let the fair go elsewhere than to steal any part of the park. The fair is a thing of a few months; the park is, or should be, a thing of forever.

But there are other sites entirely available, and the proposition to desecrate the park is one that would never be tolerated elsewhere than in this country. It has been urged that this has been done in Paris. There is no ground for such assertion. The Champ de Mars is just what would be understood by the name—a place for maneuvering the army of France. Originally it was little better than a desert—a sandy stretch of unbeautified soil. When the exposition is through it will be better for its purpose than ever, the buildings that will be left standing being required for military use.

It is scarcely more than natural that the Site Committee should look at the matter of despoiling Central Park differently from the majority of the citizens of New York. This committee is made up of very estimable men, but they are mainly men who have little interest in Central Park as a breathing place—all too small—for the multitude; men who, when the city gets uncomfortable, go elsewhere. People entirely differently circumstanced seldom look at things through similar eyes.

If the park ground is selected, the gentlemen of the committee have no assurance that they can deliver it. Existing laws prohibiting the use of these grounds for any such purpose must first be repealed, and there is no certainty of bringing about the legislation necessary to that end. If the committee finally conclude to include part of Central Park in the site, an element of doubt will be introduced that will delay preparation for some time, and antagonism will be engendered that will prevent much co-operation, of which there cannot be too much. As we have before intimated, we believe it would be better for the material interests of New York that the fair be held in Chicago, than that the precedent of slicing up Central Park be established.

Railways in China.

Those who interest themselves in the building of railroads in China are apt to encounter difficulties of an entirely different character from those encountered by projectors of similar enterprises in this country.

Some time ago, after the completion of a few miles of road in the Celestial Empire, work upon an extension was stopped because the conservatives had convinced the emperor that a fire which had taken place in the imperial palace had been caused in some supernatural way by the building of the road, and that if the business of building railroads were to proceed there was no telling where the end of such distressing calamities would be. The anxiety of the European nations to introduce railroads into China was explained upon the very ingenious theory that railroads had proven so productive of national calamities of various kinds in Europe that it had been found necessary to tear them up; and it was the discarded material and rolling stock of these abandoned roads which the barbarous Europeans were trying to unload upon China.

There was a rumor to the effect that the real cause of the fire in the imperial palace was the fact that an accounting had been called for regarding vast stores of furs and other valuable articles belonging to the emperor, of which no inventory had been taken for years, and a large part of which had mysteriously disappeared. And as they have an uncomfortable fashion of killing thieves in a very barbarous manner in China, especially when the emperor suffers by the stealing, it will be conceded that it was necessary that something should be done. The fire destroyed the storerooms in which these goods had been stored. Whether there was any truth in this rumor or not, it seems that the influence of the conservatives must be now upon the wane, for it has recently been ordered that several railroads shall be at once built in the empire. Were it not for the fact that the government will probably own and control these roads, the men who came so near getting caught in their fur-abstracting operations, might come to this country and take a few lessons in railroad stealing, after which the stealing of furs would probably be regarded by them as rather an insipid occupation.

Taxation of Manufacturers.

The town of Woodbury, N. J., has recently voted to exempt from taxation manufacturers who have $25,000 invested. It seems to us that this action simply shows that there are some rather short-sighted people in Woodbury. Twenty-five thousand dollars invested in manufacturing enterprises in Woodbury might be just as beneficial to the town and its citizens, if put into four or five small manufacturing enterprises, as it would be, if put into one larger one, and when the chances of several of the smaller establishments growing into large ones is considered, it is questionable whether, if any discrimination were to be made, it should not be in favor of the smaller ones. Many of the largest and most successful manufacturing establishments in the country to-day were started with an investment of much less than $25,000, and in fact some that we could mention whose fame is world-wide, and who are a credit not only to the towns in which they are located, but to the whole country as well, were started with little else as capital, besides the skill, intelligence and determination of a couple of young mechanics. Woodbury, or any other town, is better off with a few such enterprises, than with one large one, however desirable the latter may be; and of course we do not under-estimate the value of the large one. There is no reason whatever in the custom among towns which exempt manufacturers from taxation, of specifying the amount of capital which must be invested or the number of hands which must be employed. If manufacturers are a desirable thing at all, then small ones are as desirable in proportion to their size as the large ones, and as the taxes which can be collected from them, are also presumably in proportion to the investment, we utterly fail to see the logic by which it is maintained, that it is a good thing to tax the one, and exempt the other. We believe it is a good thing for a town to exempt manufacturers from taxation, not for a term of years only, but permanently, and not the large establishments only, but all of them. And after this is done we suggest that it would be a pretty good thing to consider the propriety of exempting the homes of the workmen also. Then if the revenue from taxation should be likely to fall below the amount required, it might be well, when looking about for something to tax, to consider the words of one of the largest manufacturers in the country, Mr. C. O. Pillsbury, the owner of the famous flouring mills of Minneapolis. He said recently: "I am bitterly opposed to this system, which is too common now, of the real estate speculators, who do nothing to improve a city, making fortunes out of what others have done. Take a lot of ground in this city [Minneapolis], and let me put a $1,000,000 mill upon it, and it would increase the value of every piece of real estate in the city. Who reaps the benefit? The man who holds vacant lots in the city, and drives workingmen out four or five miles, where land is cheap, to build their houses. The man who built the mill, instead of reaping any benefit is taxed for all this improvement, which has benefited his neighbor, the real estate dealer; but the latter has the lowest taxes, and can wait until he pleases; he is sure to make money."

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(363) A. R., Philadelphia, Pa., asks for a cut of a compound or triple expansion marine engine. *A.*—You will find illustrations of a triple expansion marine engine in our issue of Nov. 24, 1888.

(364) S. H. P., Ft. Scott, Kans., asks: Will you please advise of the method used in railroad shops for case-hardening crank-pins made of iron and mild steel? *A.*—See answer to question 263, in our issue of June 27, 1889.

(365) G. R. F., Taunton, Mass., writes: Will you kindly put me on the track of the most practical method for producing a heat for soldering, such as can be produced with gas and wind? I cannot obtain gas, and want something to take the place of it in soldering. *A.*—Use a spirit lamp and blow-pipe or a gasolene burner.

(366) G. F., Philadelphia, asks: Is it possible to put oxygen under a pressure of 130,000 pounds? *A.*—It may be possible to do so, but we do not know of such a pressure having been attained. Prof. Tyndall states that Watterer, of Vienna, in experimenting on the liquefaction of oxygen gas, subjected it to a pressure of 1,354 atmospheres, which would be 20,810 pounds.

(367) W. C. O., Yonkers, N. Y., asks: Can you give me the name and address of the makers of a shell boiler with cylindrical internal firebox and combustion chamber, with drop water flues in the combustion chamber? I think I have seen it illustrated in the AMERICAN MACHINIST. *A.*—We presume that you refer to the Kingsley boiler, illustrated in our issue of Nov. 10, 1888. These boilers are manufactured by Kingsley Steam Boiler Manufacturing Co., Washington and Water streets, Brooklyn, N. Y.

(368) C. F. B., Newark, N. J., asks: Should the back of the teeth or "land" of taps remain the same diameter as that of the cutting edge, or should it be reduced in size (or backed off) in order to give clearance? *A.*—It depends upon what the tap is to be used for. Machine taps, by which is meant all those which are used in a machine, such as a nut tapper, should be backed off; but it is not usual to back off hand taps, partly because they will do more accurate work if not backed off, and partly because, when turned backwards in the hole to take the tap out, as hand taps usually are, the chips get into the small openings made by the backing off, and make trouble.

(369) H. H., Anderson, Ind., asks: Is the use of natural gas in malleable iron furnaces a success? Please name books in which the kind of iron used is given, and the process explained in detail. *A.*—There should not be any difficulty in using natural gas for making malleable cast-iron and steel castings, although we do not know of any manufacturers who are favorably situated for using natural gas for this purpose. You will find the kind of iron and the process described in Materials of Engineering, Part 2, by R. H. Thurston; published by John Wiley & Sons, New York. Gas furnaces are described in a treatise on Iron and Steel, by W. H. Greenwood; published by Cassell & Co., New York.

(370) A. L., New York City, writes: Please inform me which is the best acid or liquid to use for soldering cast-iron. *A.*—The process is very much the same as soldering on a tinned surface. If the part of iron to be soldered is cast-iron that is hard or thin, it should be polished on an emery wheel and made clean and bright; then dip it in potash water, after which dip it for an instant in clear water, and wash it quickly with undiluted muriatic acid of the ordinary strength; go over with powdered rosin and solder made from half tin and half lead. This must be done quickly, before the surface has time to dry. Another plan is this: File the surface clean and wash as before; wipe it over with a flux made of sheet zinc dissolved in muriatic acid until it is surcharged, or is a saturated

solution, and has been diluted with its own quantity of water; then sprinkle powdered sal-ammoniac on it, and heat it on a charcoal fire until the sal-ammoniac smokes; dip it into melted tin, and then remove and rap off the surplus tin.

(371) E. L. S., Marshfield, Oregon, writes: Please give me the area of a steam port for a steam engine cylinder 4 inches diameter, 6 inches stroke, 250 revolutions per minute. Also give the size of a propeller wheel which would be most effectual for speed with a pair of engines as given above—steam pressure 150 pounds. *A.*—Area of each steam port should be about one square inch. A screw propeller should always be immersed, therefore its diameter will depend on the draught of water at the stern of the vessel. Generally the diameter of the propeller is made as large as the draught of water will allow. The draught of water at the stern of a boat suitable to your engines will probably be about three feet; hence a propeller two feet three inches in diameter will be about as large as you can use. The pitch should be about three feet six inches; number of blades, two.

(372) W. M. B., Meadville, Pa., asks: Where, in this country, can I procure "Aspinall's Enamels," which are so much advertised and used in England, or is there anything similar manufactured here? *A.*—It seems to us that the best way to ascertain whether these enamels are sold here is to write to the manufacturers whose advertisement you have seen, and ask for the address of their agents in this country; enamels are out of our line, and we are unable to answer otherwise. 2. I wish to do a little blacksmithing and smelting. Can you give me a plan for making a suitable fireplace on which I can obtain sufficient heat with natural gas? *A.*—We have not on hand any illustrations of small forges suitable for natural gas. The Phœnix Iron Works in your city use natural gas for forging, where you will probably see the kind of forge suitable for your purpose.

(373) Oil, Harrisburg, Pa., asks: How many gallons of crude oil will it take, if properly burned, to make the same amount of steam as 100 pounds of coal will do? *A.*—It is claimed that 22 pounds of water at and from 212 degrees have been evaporated per pound of oil burned. Assuming that 11 pounds of water at and from 212 degrees is a fair evaporation per pound of coal, then it will require 50 pounds of crude oil to evaporate the same amount of water that can be evaporated with 100 pounds of coal; and 50 pounds of crude oil is equal to about 6.8 gallons. 2. What size and height of chimney will be required for a return flue boiler having twenty-six 3½-inch flues 10 feet long? *A.*—The size of chimney will depend on the amount of coal to be burned, of which you say nothing. Assuming that 130 pounds of coal are to be burned per hour, then you will need a chimney about 18 inches square and 40 feet high.

(374) E. E. M., Chicago, Ill., asks: What force will be required to produce a compression of one inch in a helical spring made of ¼ inch round steel? The spring is 5 inches long, coils ⅛ of an inch apart; diameter from center to center of steel bar composing the spring, 1¼ inch. Please give formula. *A.*—In this spring there will be thirteen free coils, consequently each coil will be compressed $\frac{1}{13}$ of an inch, or, in decimals, we have .077 of an inch nearly. The weight or force which will compress one coil—that amount may be found approximately by the following formula:

$$w = \frac{E \times D^4 \times C}{d^3},$$

in which w is the weight in pounds; E, the compression of one coil; d, diameter from center to center of steel bar composing the spring in inches; D, diameter of the steel bar in $\frac{1}{10}$ of an inch; C, a constant, which, from experiments, may be taken as 22. Substituting the numerical values for the letters in the formula, we have:

$$w = \frac{.077 \times 4^4 \times 22}{1.25^3} = \frac{.077 \times 4 \times 4 \times 4 \times 4 \times 22}{1.25 \times 1.25 \times 1.25} = \frac{433.664}{1.953} = 222.2+ \text{ pounds},$$

which is the weight required to compress one coil $\frac{1}{13}$ of an inch, or to compress the whole spring 1 inch. Of course this is only an approximation; the quality of the steel and the manner of tempering the spring will affect the weight which the spring can support.

(375) Rex., Mich., writes: Please give me the distance at which I must place the safety valve weight on the lever so that my boiler will blow off at 90 pounds. I can find no rule at hand at present. The weights and dimensions are as follows: Weight of ball, 84 pounds; weight of lever, 12⅛ pounds; the lever is of uniform width and thickness throughout. Length of lever, 46 inches; weight of valve 2⅛ pounds; distance from center of valve to fulcrum, 2⅜ inches; diameter of valve 4 inches. *A.*—Let L represent the distance from the fulcrum to the center of the weight; B, the distance in inches from the center of valve to fulcrum; A, the area in square inches of the safety valve opening; P, the steam pressure in pounds per square inch; W_2, the weight of the safety valve; W_3, the weight of the safety valve lever; C, the distance in inches from the fulcrum to the center of gravity of the lever; and W, the weight of the safety valve weight. The rule for finding the distance L can be expressed by the following formula:

$$L = \frac{(P \times A \times B) - (W_2 \times B) - (W_3 \times C)}{W}.$$

The area of a safety valve opening 4 inches diameter is 12.56 square inches. Since the lever is of uniform thickness and width throughout, the center of gravity will be in the center of the lever, hence $C = 23$ inches. Now, substituting for the letters in the formula their numerical values, we have:

$$L = \frac{(90 \times 12.56 \times 2.625) - (2.5 \times 2.625) - (12.5 \times 23)}{84},$$

hence

$$L = \frac{2967.3 - 6.5625 - 287.5}{84} = 31.82 \text{ inches},$$

say 31⅞ inches, which is the distance from the fulcrum to the center of the weight. In the foregoing we have assumed that the given diameter of the safety valve is the diameter of the safety valve opening. If we are wrong in this assumption, then substitute for 12.56 the area of the safety valve opening, and proceed as before.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Gear wheels and g-cutting. Grant, see adv., p. 16.

Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc., J. B. Roney, Lynn, Mass.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Drop Presses, Punches and Shears. Williams, White & Co., Moline, Ill., manufacturers.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

Ice and Refrigerating Machines, 131 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Long & Short Hob Taps, Stove Bolt & Bit Brace Taps. M'f'd by S. W. Card & Co., Mansfield, Mass.

For drawings or special designs communicate with Arthur L. Stevens, Mech. Eng., 11 S. 9th st., Phila.

"How to Keep Boilers Clean." A 96-page book mailed free by Jas. E. Hotchkiss, 120 Liberty st., N.Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Prestoline & Prestoline Paste, for cleaning & polishing metals. S. A. Smith, 23 S. Canal st., Chicago.

Iron Planers from 16″ to 36″ wide by any length. H. C. Pease & Co., Worcester, Mass.

R. G. Du Bois, 715 11th St., Washington, D. C. Procures first class patents on inventions. Write.

Castings for small and medium sized vertical engines. Humphrey's Foundry, Bellefontaine, Ohio.

For the latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

The best emery wheel made is the "Norwich." For particulars send to Montgomery & Co., 105 Fulton st., New York.

Send $1 for Catalogue D, Fine Tools and Supplies. Over 550 pages. Fully illust'd. Free when $10 worth goods are ordered. Frasse & Co., 92 Park Row, N. Y.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Sept. 12, p. 13. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

For Portable Key-seating Machines and Stub Ends for small connections, address T. C. Dill Machine Co., 726 Girard ave., Philadelphia, Pa.

"Useful Hints on Steam." By E. E. Roberts. A book of over 80 pages; mailed on receipt of 20 cents. W. Blitz, 107 Liberty st., New York.

25″ 28″ 32″ 36″ Upright Drills a specialty. Finely made, great capacity, quickly operated, prices low. Send for list of firms using our Drills. J. E. Snyder, Worcester, Mass.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 8, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.

25″ 32″ 37″ 42″ "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.

Steam Boilers: Their management and working on land and sea. By Jas. Peattie. Practical facts from 30 years' experience. 230 pages illustrated, 12mo., cloth, $2. Circulars and Catalogue of Books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N. Y

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and Equipment well adapted for Heavy Steamship Repairs.

H. B. Roelker, 22 Cortlandt st., New York, late Sup't Delamater Iron Works, will hereafter manufacture the Delamater Screw Propeller.
Propellers of same pattern and workmanship as formerly made by the Delamater Iron Works. Each designed for its special work at lowest prices.
Consulting Expert and Constructing Engineer.
Estimates made on machinery and on damages.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including August 29, 1889 issue, 84 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 98 articles have thus far appeared up to and including the August 22, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada, at 5 cents each AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES

A company has been organized at Freeport, Ill., for the manufacture of bicycles.

The Tacoma (W. T.) Wood-working Co. has been incorporated; capital stock $500,000.

C. L. Barry, of Mansfield, O., will build a sash, door and blind factory at Tallahassee, Fla.

Hall & Danforth, Centralia, W. T., will build a planing mill and general wood-working factory.

The Hoffman & Billings Manufacturing Company, Milwaukee, Wis., is building a large brass foundry.

The Mount Pleasant (Mich.) Lumber and Manufacturing Co. has been organized, with capital of $40,000.

Jones & Pinkham are soon to start the shoe business in the old Dame & Grinnell factory at Farmington, N. H.

The Smith Bridge Company, of Ohio, has filed articles of incorporation in Texas, with a capital stock of $60,000.

Contracts have been let for building the shops of the Milwaukee Car Wheel and Foundry Company at Milwaukee, Wis.

F. W. Mumby has organized a $50,000 stock company, at Jacksonville, Fla., to make furniture, coffins, wooden ware etc.

The Chattanooga, Rome & Columbus Railroad Co. will rebuild their machine shops at Chattanooga, Tenn., recently destroyed by fire.

It is reported that the Texas Central Railroad Company will move their machine shops and roundhouse from Corsicana to Houston.

Querns Bros., Philadelphia, Pa., are building an addition to their knitting mill that will give them a frontage of 125 feet, five stories high.

The Hercules Iron Works Company has purchased a plant at St. Louis, Mo., and will manufacture car and wagon brakes, and other specialties.

J. C. Stover, South Bend, Ind., and others, have incorporated the Cook & Stover Lumber Co., capital stock $20,000, to build a hardwood saw mill.

The Frick Manufacturing Co. is building a furniture factory at Mt. Pleasant, N. C. Will also manufacture wagons, agricultural implements, etc.

An Indianapolis paper states that J. B. McElwain & Co., of that city, will shortly erect—at Kokomo—the largest boiler manufactory west of Pittsburgh.

John Baumeister, James O'Connor and Henry T. Shaw have incorporated the Louisville Saw Mill Company, of Louisville, Ky. The authorized capital is $200,000.

The Lyons Paper Mill, at Clinton, Ia., has been purchased by a stock company, which filed articles of incorporation. The mill will be crowded, it is said, to its utmost capacity.

In our issue of July 25 we said that the book *Useful Hints on Steam*, published by E. E. Roberts, would be sent free. The book is sold by W. Blitz, 107 Liberty street, New York, for 20 cents.

The Louisville, St. Louis & Texas Railroad Co. will rebuild their machine shops recently burned at Henderson, at Cloverport, Ky. The citizens raised a bonus of $20,000 to secure the shops.

A saw mill is to be erected in Ashland, Wis., this winter, on the site of the Canfield property, between Durfee's mill and the Superior Lumber Co.'s plant. It will be the largest mill in that city.

The Allegheny Bessemer Steel Company is making an important addition to their steel rail mill at Duquesne, Pa. The capacity of the mill will be increased 25 per cent. The mill is working full.

Texas papers complain that the State ships large quantities of black walnut logs to Europe, and then buys her furniture from other States, all of which indicates the need of furniture factories in Texas.

The Yost Writing Machine Co. has been incorporated at Louisville, Ky., to engage in manufacturing, by Henry Cummins, George R. Williamson and William T. Black. The capital stock is $100,000.

The Pond Engineering Co., St. Louis, Mo., will furnish the city of Seward, Neb., with a Holly duplex pump of 100,000 gallons capacity, together with the necessary boilers, heater, etc., for their system of water-works.

The J. A. MacKinnon Machinery Co., 22 Warren street, New York, are sole agents for the Gilkerson Machine Company, of Homer, N. Y. The Gilkerson Company make a variety of tools and special machinery.

It is said that Eastern capitalists are likely to get a controlling interest in the Superior Lumber Company at Ashland, Mich. The capital stock will be increased to $600,000, and large improvements will be made.

The Cleburne Foundry and Machine Company has been incorporated at Cleburne, Texas, by S. W. Wertz, V. Gray, W. T. Ramsay and others, to establish foundry and machine shops at that place. The capital stock is $10,000.

Any party desirous of locating a plant for the manufacture of machinery in a Penobscot County town, can learn of an excellent opening where the land and power will be given free, and the business exempted from taxes ten years, by addressing "F," care of this office.—*Industrial Journal.*

The 29th annual St. Louis (Mo.) Fair begins on October 7, and continues six days. The cash premiums offered amount to $70,000. On Tuesday, October 8, the grand pageant of the "Veiled Prophets" will be given. The management will leave nothing undone to make the fair a complete success.

The Sharon Steel Casting Co., of Sharon, Pa., are enlarging their works by the erection of a machine shop 60x80 feet, and two and a half stories in height. The works of the firm are being operated to their utmost capacity, and there are enough orders on hand to keep them busy for some months to come.

The National Iron and Brass Works, of Dubuque, Iowa, have been awarded the contract of supplying Fremont, Nebraska, with a Smedley compound condensing duplex pumping engine of 1,500,000 gallons capacity, together with an increase of water supply and system of mains. The contract amounts to about $30,000.

There is water-works agitation at Cisco, Texas; Fenton, Mich.; Madisonville, Ohio; Upper Sandusky, Ohio; Butler, Mo.; Rock Rapids, Iowa; Iowa Falls, Ia.; Cottage City, Mass.; Denver, Ind.; Winchester, Ky.; Augusta, Ga.; Griffin, Ga.; Blowing Rock, N. C.; Princeton, Ky.; Baird, Tex.; Antigo, Wis.; Madisonville, Wis.; Rockdale, Tex; New Westminster, W. T.; Seward, Neb.; Troy, Ala.; Central City, Ky.; Hendersonville, N. C.

The Dunlap carpet factory, of Philadelphia, will be removed from that city to Pottstown, Pa. The old Philadelphia & Reading Company's carpenter shop property, comprising buildings, engine and boiler, and about 300x360 feet of ground, has been secured. A large amount of the capital stock has been subscribed by citizens of Pottstown, as an inducement to the removal, and the new works will employ from 400 to 600 hands, manufacturing a fine grade of carpets.

Robert Poole & Son Co., Baltimore, Md., have issued the eleventh edition of their Catalogue on Gearing. This firm is well known throughout the country in connection with gearing, particularly for work of a heavy class. Their list is very complete, and, in addition, they have a very fine plant for making machine-moulded gears. In addition to the gear list and illustrations of transmitting appliances made by them, the Catalogue contains many convenient tables and rules. It is an excellent Catalogue to have at hand.

At a meeting of the stockholders of the Callahan County Mill, Gin and Water Company, Baird, Tex., an organization was effected, and the following directors and officers were elected: Directors—J. R. McLeskey, Frank Sears, J. W. Jones, J. P. Massie, W. L. Jones, John Couch, William McManis, W. E. Gilliland, T. E. Powell, D. Richardson and J. L. Lea. Officers—J. L. Lea, president; W. E. Gilliland, secretary; W. C. Powell, treasurer. The company will at once make application for a charter, and will purchase the mill building already here and fill it with new machinery throughout.

The *Steelton Reporter* says: There is a gradual improvement in the outlook for business for the balance of the year, and all the departments of the works of the Pennsylvania Steel Company are in operation, and many of them have pressing orders. The Bessemer department made but an ordinary run this week, owing to several detentions in other departments. The open-hearth plants were on special steels, and made a good output. The boiler shop is very busy, and workmen are absent erecting work. The machine shop is also crowded with orders, and the employes were compelled to work at night this week. The frog, switch and signal department is, as usual, crowded with pushing orders, and is kept running day and night.

The Minnesota Iron Car Company has filed articles of incorporation for a reorganization of the Minnesota Car Company, of Duluth, Minn. The company will have a capital stock of $2,000,000, and the general nature of its business, as stated in the articles of incorporation, is to smelt iron and other ore, to manufacture pig-iron and its kindred products, railroad cars of all descriptions, locomotives, marine and stationary engines and machinery, iron and steel rails and plates, railroad fastenings, bar-iron and forgings of all kinds, and castings of iron, steel, brass and other metals, malleable iron, tubes of iron or steel, metals for structural purposes, and all materials necessary for or incident to the production of railroad equipment and construction, and for any other purpose.

Machinists' Supplies and Iron.

NEW YORK, Sept. 28, 1889.

Iron—American Pig.—The market has ruled steady, and no changes of importance have taken place since our last report. We quote, Standard Northern brands, No. 1 X Foundry, $17 to $18; No. 2, $16 to $17. Southern brands, No. 1, $16.75 to $17.25; No. 2, $16 to $16.50. Northern brands, Grey Forge, $15.25. Southern brands, $15.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Mechanical draftsman wanted. Address with full particulars, O. E., care AMERICAN MACHINIST.

Mech. draftsman and designer with practical shop experience, wants position. Box 26, AM. MACHINIST.

Foundry foreman (machine) wants situation. Address Boomer, AMERICAN MACHINIST.

Mech. draftsman with 9 yrs. mfg. & designing exp. wishes permanent situation. Box 28, AM. MACH.

An exp. mech. draftsman wants position. N. Y. or vic. pref'd. Address C. P., AMERICAN MACHINIST.

A mech. engineer, widely exp'd in designing, estimating, m'f'g, superinten'g, etc., is open for engagement in any location. "Nom," Box 321, Chicago, Ill.

Machinists wanted—Two first-class job hands, and one machinist and blacksmith. Permanent hands. No saloon patrons. J. H. Wells, Tampa, Fla.

Wanted—Position by an expert brass finisher in the manufacture of steam heating specialties and wrought-iron pipe fittings. "Expert," AM. MACH.

Wanted—A position as machine shop foreman, 15 years' experience on engine and general mill work. Address Box 217, Havana, New York.

Wanted—By a practical machinist and experienced foreman, a position as superintendent or foreman. Address J. L. A., AMERICAN MACHINIST.

Wanted—Draftsman for pumping mach'y, condensers, engines, etc. Men of thorough exp. only need apply. Buffalo Steam Pump Co., Buffalo, N. Y.

Wanted—A first-class tool maker for brass finishing shop at Croton Falls, N. Y. Steady job. Best references required. Address F. N. DuBois, 245 Ninth ave., New York City.

Wanted—Two good lathe hands in a shop engaged in the manufacture of wood-working machinery. Married men preferred. Steady work for right men. Jenkins Machine Co., Sheboygan, Wis.

Wanted—A foreman; a good blacksmith, accustomed to the care of a shop, and experienced in the use of forging machines for forging small articles. State age and experience. R. C., AM. MACHINIST.

Wanted—Mechanical draftsman experienced in light machinery and well posted on shop practice. Letter stating age, nationality, experience, and wages expected. Address "South," care AM. MACH.

Machinists Wanted—Vise hands accustomed to first-class work. Steady employm't and liberal wages guaranteed. Have largely increased our plant and need more men. Niles Tool Works, Hamilton, O.

Wanted—Situation as draftsman or ass't sup't. Tech. education. Excellent draft'g-room exp., associated with modern pattern, mach. shop and foundry practice. Good refs. Engineer, Box 174, Fairfield, C't.

A machine foreman, designer and draftsman, with experience managing men and shop manufacturing fine tools and interchangeable machinery, wishes to correspond with parties in need of such a man. Address G. W. N., AMERICAN MACHINIST.

Wanted—Foundry foreman. Must be thoroughly competent to take charge of foundry and handle men to good advantage. Address, giving references, and state class of work you have been accustomed to doing, "Foundry," AMERICAN MACHINIST.

Wanted—Machinists. A steam engine mfg. shop wishes to put on a full night force of about 100 men—first-class men—for lathes, planers, milling machines, drills, blacksmiths, tool makers, etc. Can secure steady employment and good wages—largely by piece-work. Will work 12 hours each night for 5 nights per week. Address, with references as to capacity and character, Box 841, Pittsburgh, Pa.

We desire to engage the services of two first-class men to take charge respectively of our Drill Press and Planer Departments. In addition to being first-class mechanics, they must be live men and readers, who keep themselves posted and abreast of the best and foremost ideas of the times. They must be able to handle men, and possess that rare qualification—executive ability. They will not be hampered, being responsible only to the general manager. Study yourself well, and ask some disinterested party, in whom you have confidence, if they think you can fill the bill, before you apply, for we will study you well after you apply. The Lodge & Davis Machine Tool Co., Cincinnati, Ohio. Wm. Lodge, General Manager.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Cheap 2d h'd Lathes & Drills. S. M. York, Clev., O.

Koopman's Scales for quick measurements.

Just out; aluminum-steel hack-saws, hard but not brittle. Crescent Mfg. Co., Cleveland, O.

New catalogue of engineers' specialties free. Crescent Mfg. Co., Cleveland, O.

Wanted—Machine for making small double bent wire. St. Louis Screw Co., St. Louis, Mo.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State st., N. Y., Consulting Engineer. Designs of all kinds of Machinery.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Complete list of our Scales and other new tools for 2c. stamp. A. T. Koopman, Chicago.

D. J. Kelsey, M. E., Designer of Automatic Machinery, 31 Insurance Building, New Haven, Conn.

Latest and best Planer and Drill Press Chucks. Expanding Mandrels. The Brightman Machine Company, Cleveland, O.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Lord & Co., P. O. Box 1262, Phila., Pa.

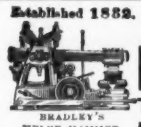
Wanted—Ericsson 8-inch pump or Lawson gas engine No. 1; second-hand. State price and condition. Box 27, AMERICAN MACHINIST.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

Wanted—As partner, a smart man with $10,000 or $15,000, to engage in the manufacture of a new machine, patented in Great Britain, Canada and United States. First-class in every respect, as testimonials from parties using them will show. Have been selling them for the past two years. Shop all fitted to manufacture same. Address Manufacturer, P. O. Box 1196, Boston, Mass.

Established 1832. BRADLEY'S POWER HAMMERS



The BEST in the WORLD

RUN BY BELT.

BRADLEY'S MELVE HAMMER.

Over 1500 in USE

BRADLEY'S UPRIGHT HAMMER.

BRADLEY'S UPRIGHT HAMMER.

BRADLEY'S HEATING FORGES

Indispensable in all shops to keep BRADLEY'S CUSHIONED HAMMERS and men fully employed and reduce the cost of production.

BRADLEY'S HARD COAL HEATING FORGE.

BRADLEY'S SOFT COAL FORGE.

BRADLEY & CO. SYRACUSE, N.Y.

43 Murray st. NEW YORK. 98 Sudbury st. BOSTON. MASS.

TO BUYERS AND USERS OF MACHINERY.

You will save money and get what you pay for by having us examine machinery and report on the same before buying. Try us and be convinced.

We also make drawings and blue prints, and give SPECIAL ATTENTION TO THE DESIGNING OF MACHINERY FOR ALL PURPOSES. Send for Blue Book giving more information.

JONES & MACK,

MECHANICAL ENGINEERS,

5 W. 4th Street, Cincinnati, O.

SOLID EMERY AND Triple Coated OIL STONES KNIFE SHARPENER

WHOLESALE ONLY BY THE TANITE CO., STROUDSBURG, PA.

MANUFACTORY SHEFFIELD, ENGLAND.

Chief American Office, 91 JOHN ST., NEW YORK.

WM JESSOP & SONS LT'D. BEST TOOL STEEL NEW YORK.

ALL KINDS OF STEEL in STOCK.

IMPORTATION ORDERS PROMPTLY FILLED.

HENRY CAREY BAIRD & CO.,

INDUSTRIAL PUBLISHERS, BOOKSELLERS AND IMPORTERS,

810 Walnut St., Philadelphia.

☞ Our New and Revised Catalogue of Practical and Scientific Books, 80 pages, 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.

LUSCOMB & COREY,

NEW BEDFORD, MASS.

Mfrs. of

UPRIGHT DRILLS,

SPECIAL

Machinery & Tools.

This machine will drill to the center of 16 inches.

The spindle can be fed by either HAND or FOOT, and has a vertical movement of 11 inches. *Also an entirely new* feed arrangement.

Cone has four changes and all moving parts are balanced and capable of standing high speeds. It is very stiff and heavy and is made for doing first-class work.

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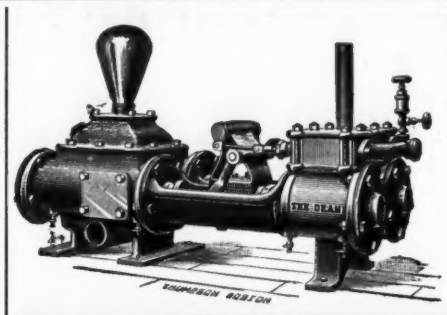

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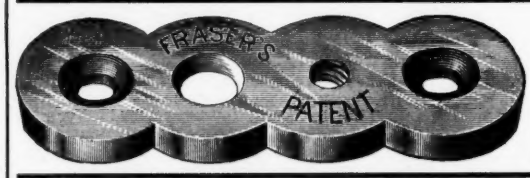

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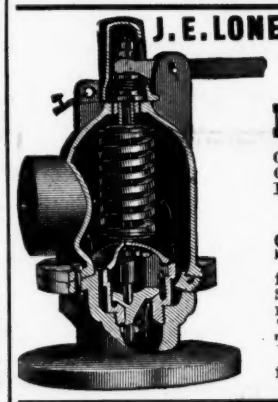

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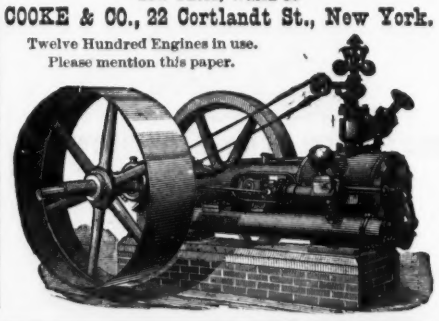

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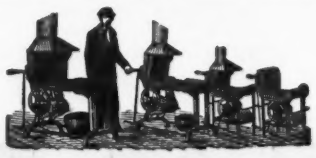

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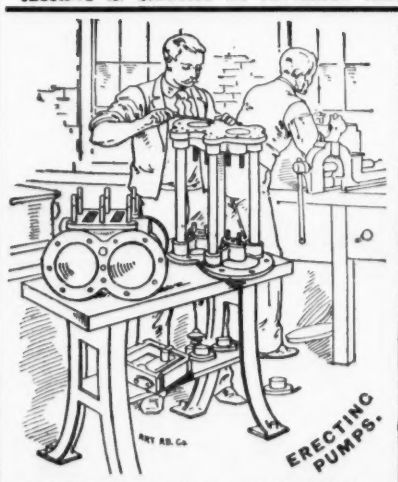

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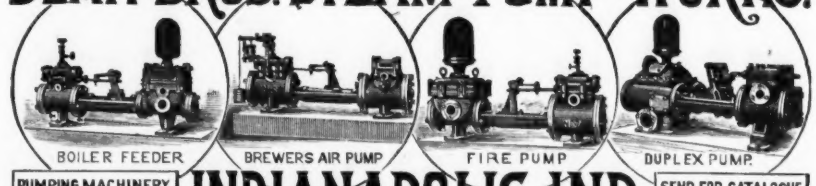

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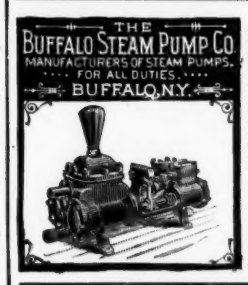

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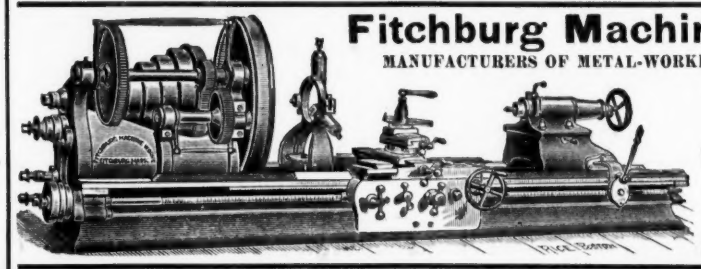

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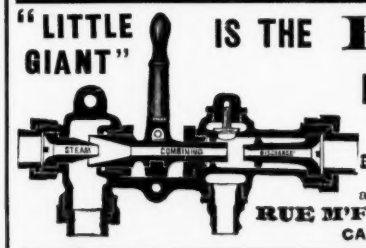

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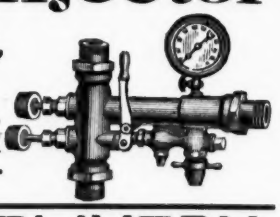

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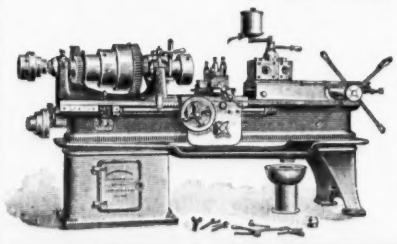

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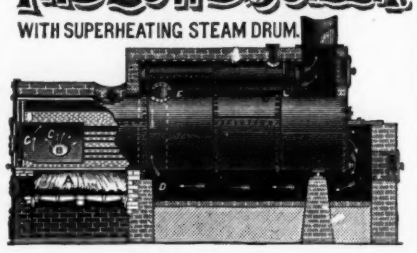

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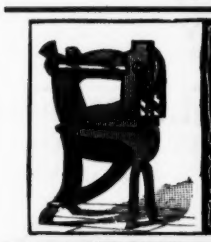

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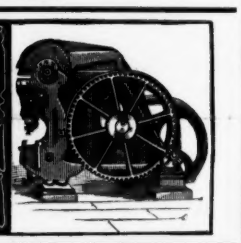

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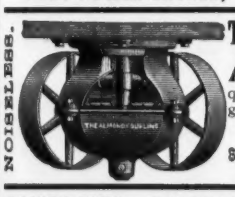

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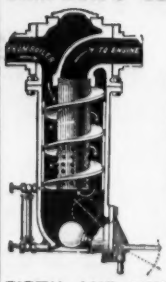

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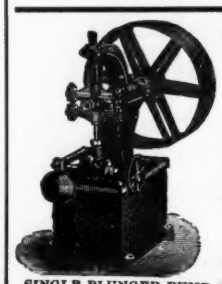

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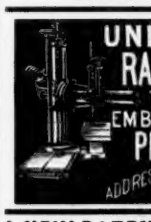

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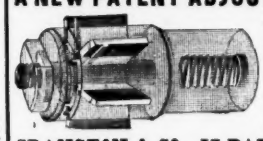

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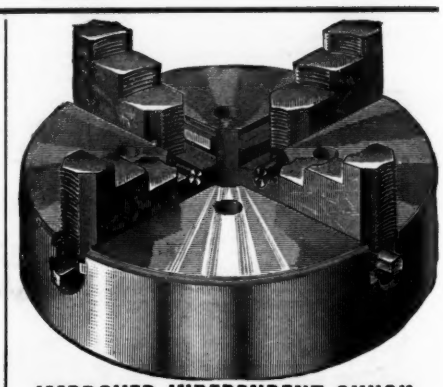

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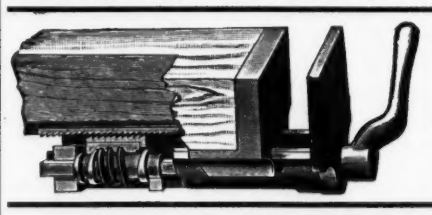

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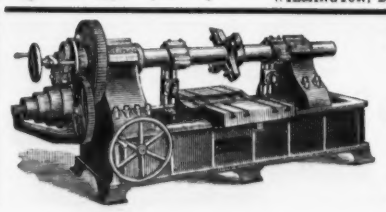

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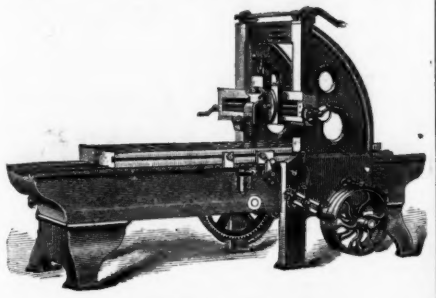

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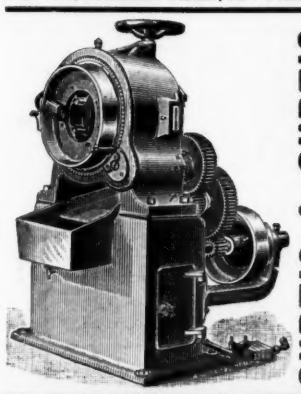

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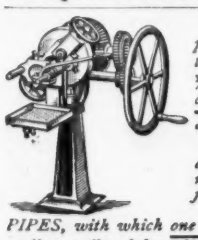

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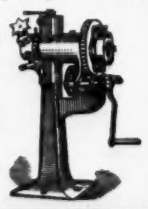

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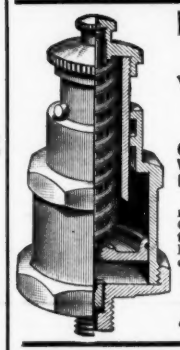

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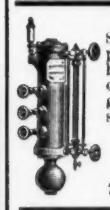

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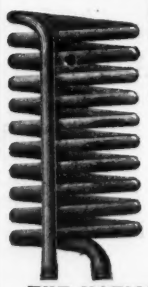

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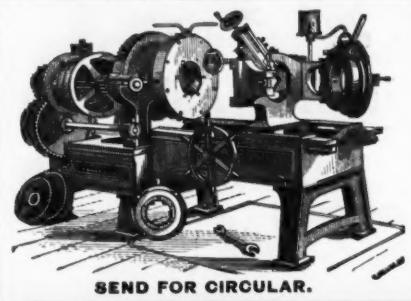

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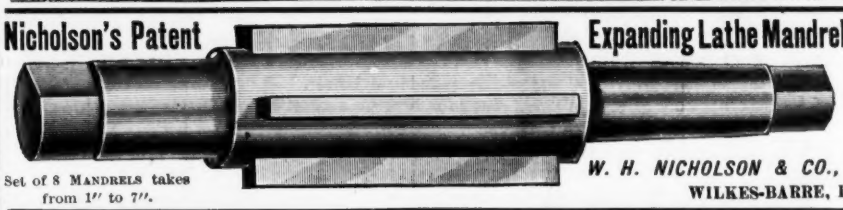

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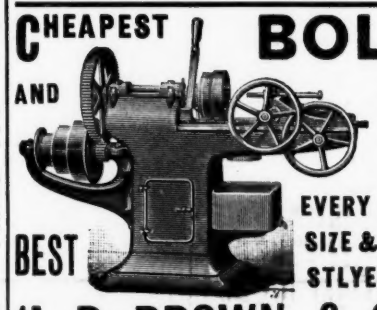

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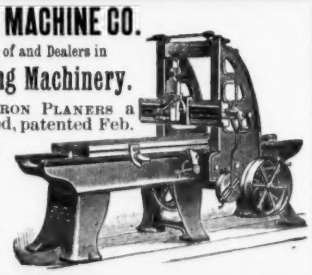

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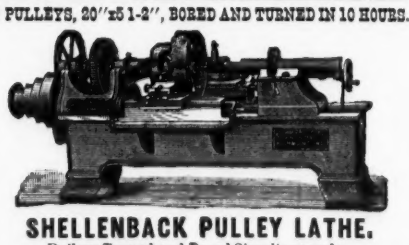

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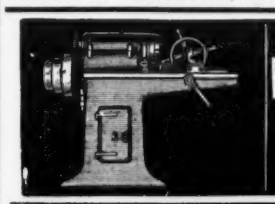

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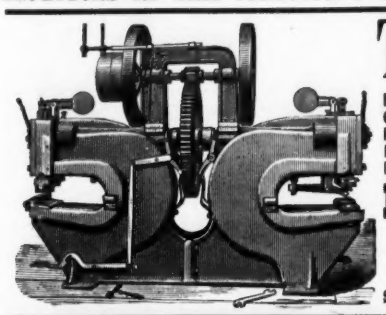

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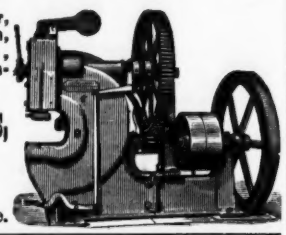

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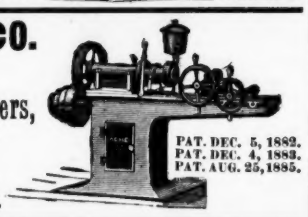

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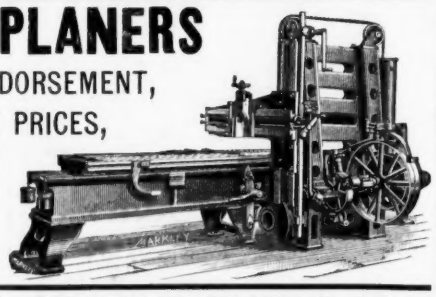

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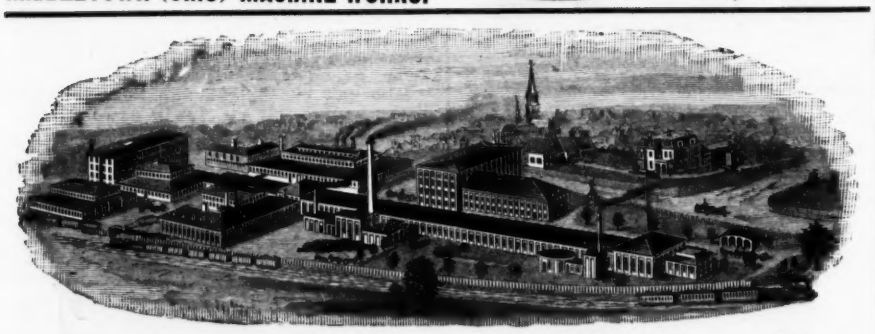

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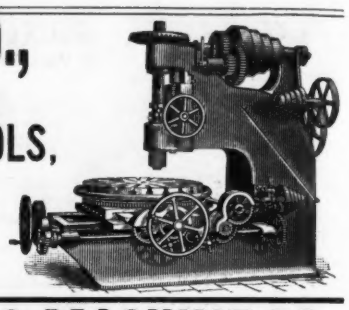

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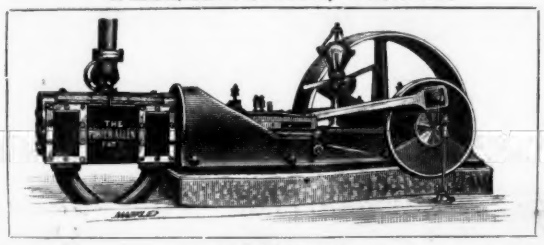

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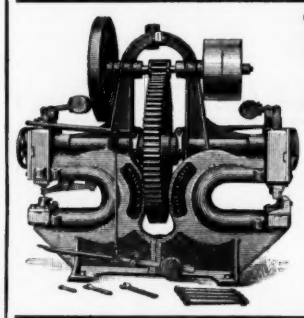

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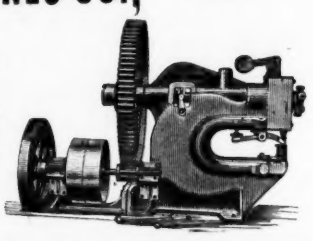

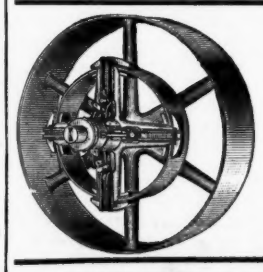

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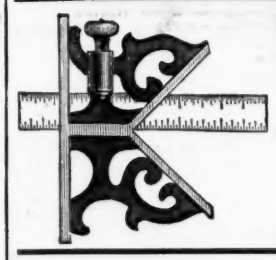

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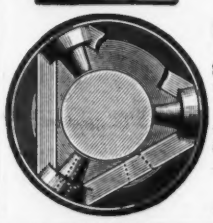

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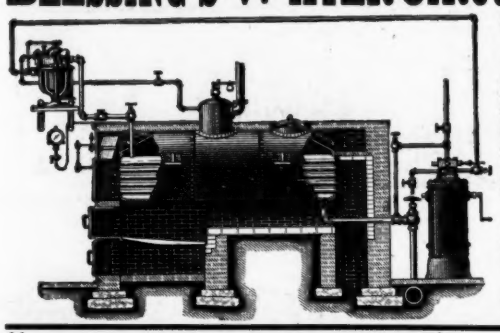

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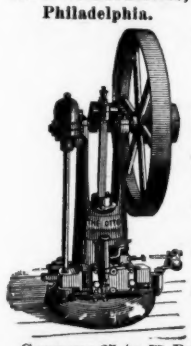

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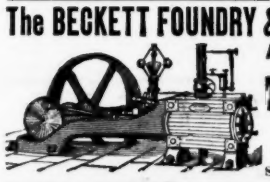

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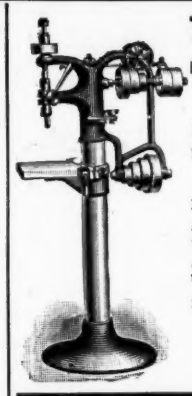

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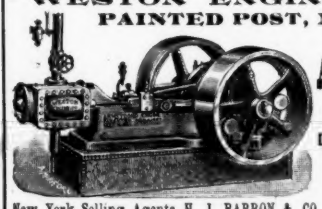

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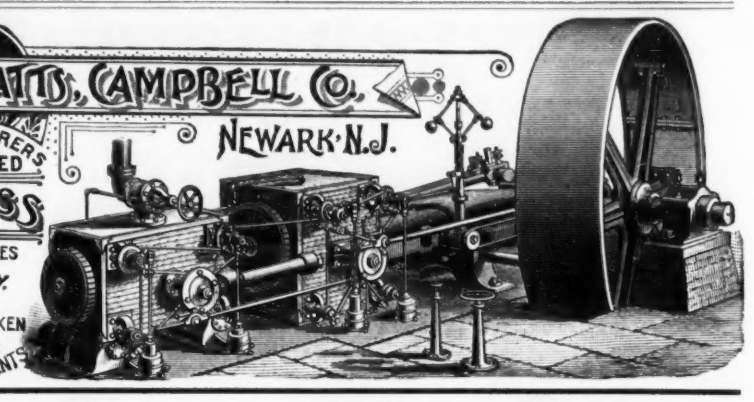

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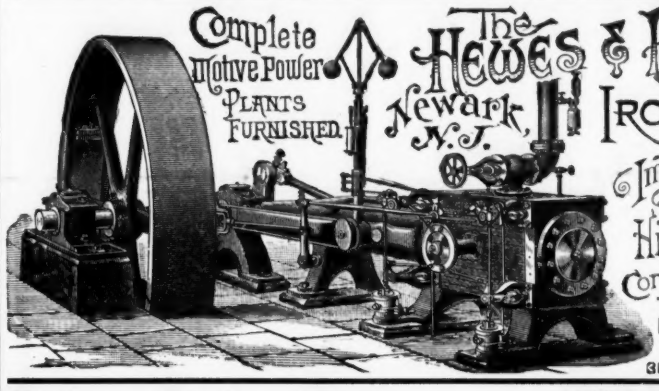

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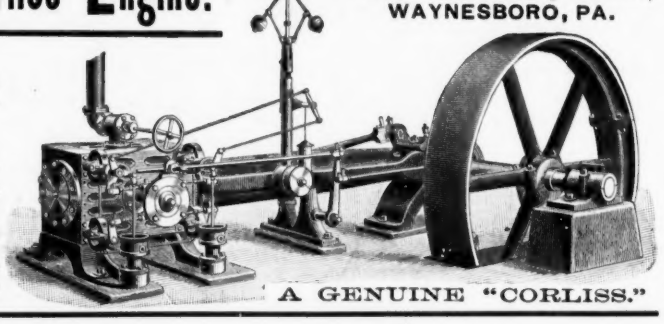

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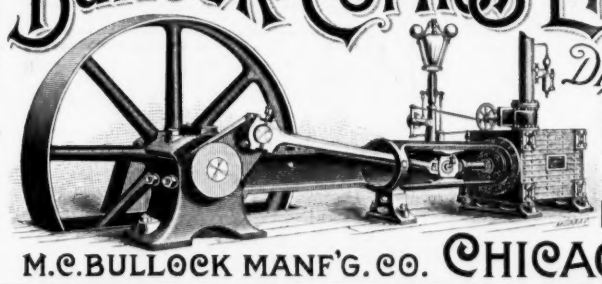

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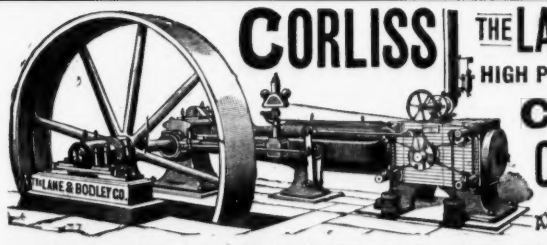

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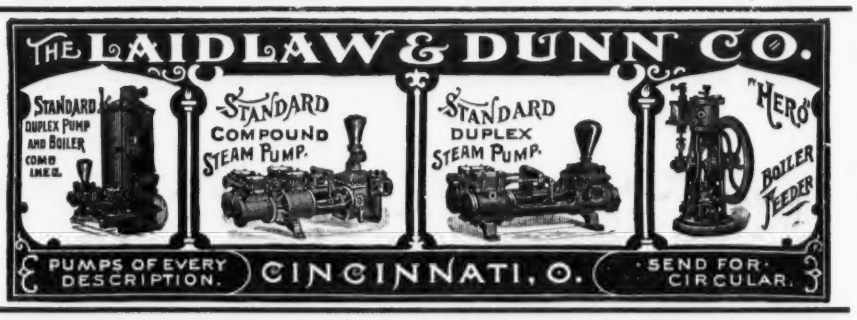

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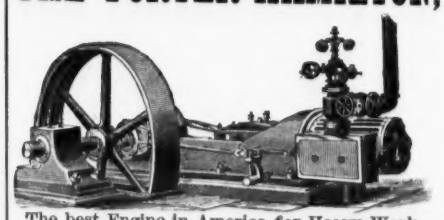

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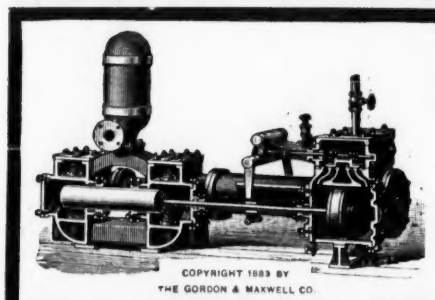

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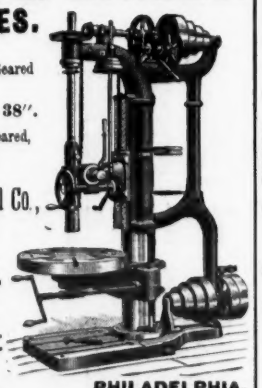

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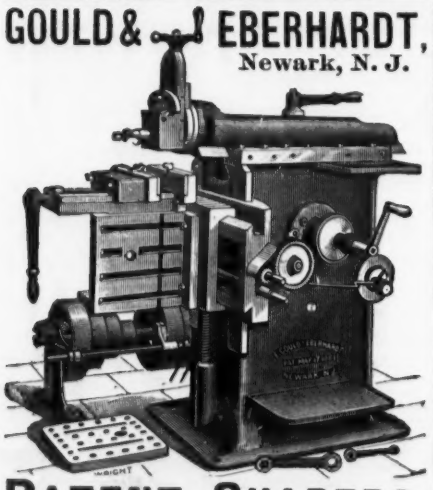

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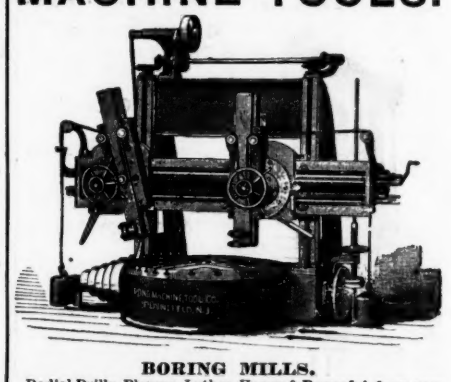

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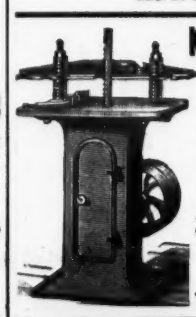

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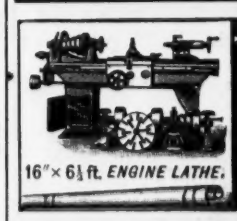

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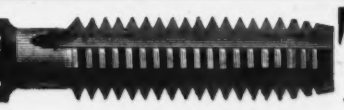

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